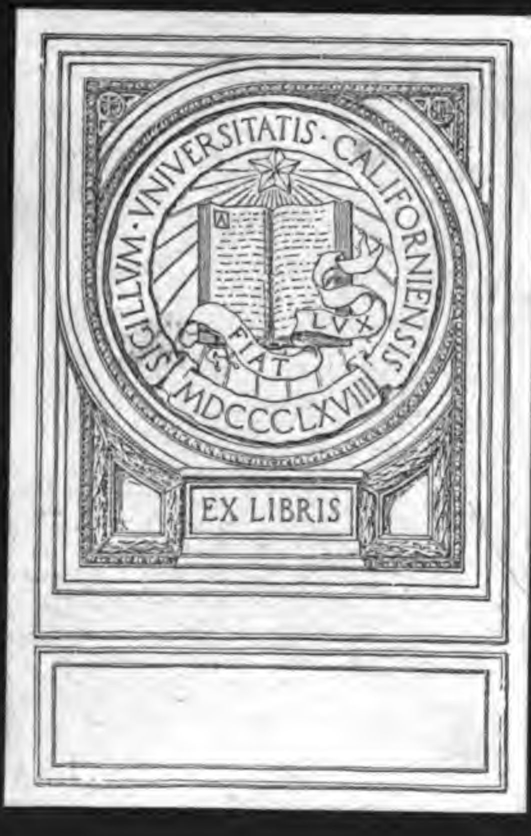
SIGILLVM · VNIVERSITATIS · CALIFORNIENSIS
FIAT LVX
MDCCCLXVIII
EX LIBRIS

Challing [illegible]
Boston [illegible]
Sept 2/92

THE HYGIENE
DISEASES AND MORTALITY
OF OCCUPATIONS

THE HYGIENE
DISEASES AND MORTALITY
OF OCCUPATIONS

BY

J. T. ARLIDGE

M.D., A.B. (LOND.), F.R.C.P. (LOND.);
CONSULTING PHYSICIAN TO THE NORTH STAFFORDSHIRE INFIRMARY;
LATE MILROY LECTURER AT THE ROYAL COLLEGE OF PHYSICIANS, ETC. ETC.

London
PERCIVAL & CO.
1892

TO

SIR ANDREW CLARK, Bart.

M.D., LL.D., F.R.S., ETC. ETC.

PRESIDENT OF THE ROYAL COLLEGE OF PHYSICIANS OF LONDON

IN RECOGNITION OF THE ENCOURAGEMENT AND KINDNESS
RECEIVED ON THE OCCASION OF THE DELIVERY OF
THE MILROY LECTURES BEFORE THE COLLEGE,

THIS TREATISE,

BASED ON THOSE LECTURES,

IS BY HIS PERMISSION DEDICATED BY

THE AUTHOR

PREFACE

THE present work owes its origin to the circumstance that I had the honour of being appointed, in 1889, 'Milroy Lecturer' at the Royal College of Physicians of London. The conditions of the endowment required that the subject of the lectures should be connected with public or preventive medicine. Therefore, having had my attention for many years directed to the hygiene and diseases of occupation, I felt it was a subject I could best discourse upon; and that, too, it was one which possessed the charm of novelty, inasmuch as few British physicians had studied it, and no treatise had been written upon it for a long series of years, although its importance could not be denied.

The reception accorded to the four lectures given was highly gratifying; and still more so was the request conveyed to me by the distinguished President of the College, that I would print them in book form. But, though flattered by this request, I considered that, as the opportunity offered by the course allowed only of the consideration of diseases consequent upon the inhalation of dust, the publication would represent no more than an isolated chapter of a very wide topic; and that, therefore, it would be better to delay until I could present a general outline of the hygiene, diseases, and mortality of all the principal occupations pursued in this country.

Very soon I found I had entered on a task of great magnitude, to fulfil which demanded very extensive acquaintance

with the works of numerous writers, and the necessity for extending my existing knowledge of manufacturing processes by visits to factories and workshops in different parts of the kingdom. Hence the delay in the appearance of this treatise.

Considering that manufacturing processes are in a constant state of fluctuation, I have avoided elaborate technical details, and selected only those principal operations which present distinct bearings upon health. But, even in describing these, I doubt not those engaged in the several manufactures noticed will discover errors and omissions in my account of technical proceedings; for all such, I must ask their indulgence, and also that they bear in mind that my object has been to exhibit as concisely and correctly as possible those processes which obviously affect the health of operatives, or appear well calculated so to do.

Where I have been unable to see manufacturing processes for myself, I have referred to the best notices of them within my reach, and have placed myself in communication with medical men practising in the chief manufacturing towns of the country, who possessed the fullest opportunities of supplying me with the information sought.

In the preceding remarks, I have laid special stress upon manufactures and manufacturing operations; the scope of this treatise, however, is far wider, and includes the examination of the sanitary conditions of all professions and trades; and not these matters only, but likewise the sickness and mortality statistics of all occupations dealt with.

On the last-named subject, insuperable difficulties stand in the way of a satisfactory account. Statistics of occupations in particular are not collected, except in a few rare instances. Those that have served me best are contained in the admir-

able prefatory chapter written by Dr. W. Ogle, and published in the 'Supplement to the Forty-Fifth Annual Report of the Registrar-General.'

The small use I have made of foreign statistics, considering that the great continental writers present mortality statistics for almost all employments, has been due to a consideration of the very dissimilar conditions of life and work on the Continent and in England. My conviction is, that the vital statistics of occupations as pursued in England can only be obtained from English sources.

It requires no argument to prove that a man's occupation must, after a longer or shorter period, react upon his mental and corporeal condition. The circumstances and surroundings of a man operate, in some instances for his advantage, but, in the greater number, are adverse, in some direction and measure, to his health. Many trades exhibit features distinctly injurious, especially to bodily soundness, by conditions inseparable from them; still more operate by circumstances that may be pronounced accidental, though often of greater potency for evil.

The main purpose of this volume is to elucidate and illustrate this truth, to which, in my opinion, far less attention has been given than it deserves. It is as essential to the medical man to acquaint himself with the occupation of a patient, as an important health-factor, as with the hygiene of his home and neighbourhood, or with his family history. And it is for him important to arrive at a correct estimate of the part played by employment in producing the symptoms he detects, or in causing the mortality he has to regret.

If what I have written arouse attention to these matters, it will be the best reward attainable for my labour.

It is a pleasing duty to put upon record the names of those friends who have most kindly helped me to valuable information, and I tender them my most cordial thanks. I will mention Sir G. Buchanan, late Chief of the Medical Department of the Local Government Board; Dr. Edward Ballard, a distinguished member in the same department; Dr. Dickson, Chief of the Customs Medical Department; and Messrs. T. Holmes and Gordon Brown; the former, the head in past years, of the medical service of the Metropolitan Police, the latter, that of the City of London Police, and still holding office. But besides these public officials, I will name among private medical men Drs. Charles Brown, of Preston; Hogben, of Birmingham; Totherick, of Wolverhampton; Hartill, of Willenhall; Purdon, of Belfast; Roberts, of Festiniog; Eben Davies, of Swansea; Bowhay, of Gunnislake, Devon; Mr. W. Ballard, one of the Inspectors under the Chemical Act, and Captain May, a District Factory Inspector. Moreover, several gentlemen attached to Life Assurance Companies kindly helped me in my quest for statistics, among whom I will name Mr. Whittall, Actuary of the Clerical, Medical, and General Assurance Society, and Dr. Muirhead, the principal Medical Officer of the Scottish Widows' Fund Assurance Society.

I must also not fail to express my best thanks to those many manufacturers who accorded me the privilege of going over their factories, and witnessing the principal processes carried on. They will do me a further service by notifying me of errors in technical descriptions, where such errors affect conclusions arrived at.[1]

[1] The 'Milroy Lectures' were published, in very full abstract, immediately after delivery, in the *British Medical Journal* and in the *Lancet*.

CONTENTS

CHAPTER I.

INTRODUCTORY AND HISTORICAL.

CHAPTER II.

CONDITIONS AND CIRCUMSTANCES OF LABOUR.

CHAPTER III.

STATISTICS IN RELATION TO CONDITIONS OF LABOUR.

CHAPTER IV.

CLASSIFICATION OF OCCUPATIONS.

CHAPTER V.

SUPPLEMENTARY ON THE PATHOLOGY OF DUST INHALATION.

MINING AND MANUFACTURE.

CHAPTER I

INTRODUCTORY AND HISTORICAL

General Observations.—The problem to be solved is to determine not merely the mortality and relative prevalence of particular diseases in the several occupations, but to discover what, if any, pathological consequences are rightly assignable to them, and what, when such are found, are their causes. It is not sufficient to analyse the returns of sickness and mortality. To arrive at a correct estimate of the effects positively attributable to an occupation, it becomes necessary to eliminate all factors of disease not truly incident to it,—a proceeding of great difficulty even when practicable.

Nevertheless, it is quite possible to discover what diseases are most prevalent in any given trade, and thereupon to investigate their probable causes by consideration of the vital conditions of the occupation. It is, indeed, only from a correct appreciation of the conditions of any form of labour that we can hope to understand and explain the consequences to health with which its pursuit makes us cognisant. Having got thus far, we must trust to the teaching of pathology and of experience to interpret the phenomena, and to apportion to the several conditions their part in their production. Moreover, to make the task complete, the history of the lesions encountered need be followed from their earliest development to their final issue in destruction of function and disorganisation of tissue.

For instance, a group of symptoms may occur in connection with an occupation, such as cough, dyspnœa, and wasting, and it becomes a duty to establish what their connection with it really is, to remark wherein they differ from a similar series identified with some particular disease having

no relation to the employment in question. In short, our business is to differentiate between the two symptomatically and pathologically, and from the conclusion arrived at to judge what has been the *modus operandi* of their respective causes.

In certain occupations the cause and the symptoms of the prevalent maladies are sufficiently clear, as happens when the lesions follow upon dust-inhalation or the introduction into the system of poisonous materials. But there is a large class where no obvious cause is apparent and preponderant to account for the diseased phenomena. And in all instances the determination of the actual or chief factors in the production of disease is embarrassed by the presence of numerous collateral or accidental circumstances of labour.

Every definite employment involves some circumstances which may give rise to disease. What these circumstances are, how they exert their power, and with what results, is an inquiry that has usually received but scant attention. Attention has been directed almost exclusively to those diseases described in medical nosologies, and to the ordinary catalogue of causes, consequently the lesions and sicknesses attending upon employment have been overlooked, or, if recognised, their pathology has not been followed up. But failure to inquire respecting the occupation, and a want of knowledge of its working conditions and customary ailments, places the doctor at a disadvantage towards his patients, and deprives the latter of the full benefit of treatment.

For a long period physicians have been aware that the inhalation of dust is followed by symptoms greatly resembling those of tubercular phthisis, bronchitis, and asthma, but which are really due to fibrosis of lung tissue. In too many instances little pains have been taken to differentiate between the last-named and either of the former lesions, and very few efforts made to elucidate the minute pathology of dust-produced pulmonary mischief. In my search for facts relative to the changes wrought in lung tissue by the presence of dust arising from textile materials,—silk, cotton, wool, and linen,—I have been unsuccessful in finding any placed on record by medical men practising in the numerous and large manufacturing towns wherein those substances are in daily

use, and in some of which are medical schools with professors of medicine and pathology. In registering cases of sickness and death of patients suffering the lesions in question, it appears to be deemed sufficient to enter them as examples of bronchitis, or asthma, or consumption, without further investigation.

Be it far from me, however, to imply a general and total neglect of the symptomatology and pathology of industrial diseases. There are brilliant exceptions to the contrary, chiefly found among those attached to the medical department of the Local Government Board, who primarily derived the inspiration of inquiry from Sir John Simon, to whom sanitary science in all its branches is so deeply indebted.

To investigate the sanitary conditions of all known occupations, and to discover their effect upon the employed, clearly is an undertaking beyond the powers of any single student of industrial diseases. It is incumbent on him to look on all sides for contributory information. In so doing he will soon discover that the mass of material available is of continental origin. The physicians of France and Germany have for a long series of years directed their attention to the class of diseases in question. The use made of these observations is perhaps not so considerable as might have been expected.

The racial characteristics, the usages, and habits and the dietary of foreign artisans differ from those of our own, and must exercise more or less influence upon the health consequences of occupations. Again, the hours of employment are longer and more irregular, many of their mechanical appliances and processes of manufacture are different in kind, and, on the whole, the sanitary conditions of their factories and workshops are inferior to those of this country, and the public provisions made for the sick have a different character.

At the same time, it must be admitted that the central and municipal authorities possess powers of supervision over places of employment and processes of work not existent in this country; and that no few foreign factories might serve as models for our own. The workmen, also, are more amenable to discipline and more observant of regulations than their

colleagues in England. Such variety in conditions of occupation implies variety in health consequences, and will make itself felt in statistical comparisons.

Another fact that lessens the value of foreign works on the effects of employments upon health and life, is that several of the most important of their number,—for instance, Hirt's comprehensive treatise on diseases of trades,—were published many years since. This fact detracts greatly from them as authorities at the present day. For the division of labour is ever going forward and undergoing modifications; new trades arise; and, above all, one process of manufacture succeeds another almost faster than note can be made of it. Our own manufactories and modes of manufacture have also undergone transformations quite as great, and even greater, particularly where machinery is largely used. Above all, we are ahead of all other lands in legislation for the benefit of the operative classes, in prescribing the hours of work and of meals, and in enforcing regulations to prevent accidents, and to secure general cleanliness and sanitation. In short, the Factory Acts have worked a great reform in the construction and management of factories, and in the general physical wellbeing of the working population. Abroad, and especially in France, there are extended codes of rules and regulations to govern factories, and to give security to the public against noxious trades; but elaborate though they be, they are to a serious extent inoperative, because there is no consolidated system of supervision by a distinct body of factory inspectors and medical men. However, foreign governments do now recognise the excellent system of factory laws enforced in this country, and are fully alive to the necessity for official oversight of manufactures in the interest of the lives and health of those occupied in them.

If the State has done its part towards lessening the evils of factory labour, it cannot be admitted that those who derive the benefit have done, or are doing, the best for themselves. When visiting manufactories, the visitor is almost invariably informed that the particular manufacture therein pursued is a very healthy one. Even in cases where the contrary is a matter of general knowledge, and demonstrated by statistics, it is no uncommon thing to find the matter treated as of very

little moment. If undeniable, the evils are minimised, and masters and managers are prone to close their eyes to conditions of labour that loudly call for a remedy, and cast the blame, more or less, upon the work-people. Unhappily, this is too frequently justified by the conduct of the latter. For it requires no very lengthened acquaintance with workmen to discover their recklessness in dangerous occupations, their neglect of cleanliness, their refusal to adopt preventive measures against evident evils, and, above all, their widespread habit of intemperance.

This last-named fact, in short, furnishes the owners of factories with the best apology for whatever ills their business exhibits. The trade, we are constantly assured, is a healthy one on the whole; and should disease and death be proved to attend its processes, this fact is put down to the intemperate and irregular habits of those employed.

Another common incident, when the healthfulness of an occupation is called in question, is to direct attention to some old operatives, found here and there, who have worked at it for many years, as a triumphant vindication of its sanitary character. It is forgotten that the continued existence of such ancient workers witnesses to nothing else than their superior vitality, and that the large number coeval with them have vanished.

On a retrospect, I am forced to the conviction that the material and moral improvement of manufacturing operatives during the many years every effort has been exerted in their favour by factory legislation, by sanitary laws, by the cheapening of food and clothing, and by the political and educational privileges accorded to them, and by the advance of wages, has not proceeded to the extent their well-wishers could fairly look for.

There is much to be said in commendation of the action taken by masters to improve their factories and the condition of those they employ, but the stimulus to it has come to a large extent from outside; firstly, by the influence of factory inspection; secondly, by the force of public opinion, the fruit of ever-increasing recognition of sanitary laws; and thirdly, by the pressure of trade competition demanding superior buildings, machinery, and processes to accomplish results

more speedily and profitably than aforetime. Experience proves almost without exception that improvements in these particulars operate in favour of the health of the employed.

Historical Sketch of the Literature of Industrial Diseases.

Many physicians had remarked a causal connection between various employments and the diseases of those engaged in them, but the fruit of their observation was scattered until Ramazzini undertook the examination of the entire subject, and brought to bear upon it his own careful observations. Bernardino Ramazzini was born at Carpi, in the Duchy of Modena, in 1633, and became Professor of Physic in the old and renowned University of Padua. In 1700 he produced his memorable treatise *On the Diseases of Tradesmen*, with the title of *De morbis Artificum Diatriba*. According to the custom of the age, it was written in Latin, but its merits being speedily recognised, it found translators in different countries. The earliest translation with which I am acquainted is an English one, published in 1705, but the author was too modest to attach his name to it. Fourcroy made a translation into French in 1777, but this was long after a German version had been produced. In 1715 a new edition, containing twelve additional chapters, was published in Padua.

The reputation of the book is so universally admitted, that it requires no encomium from me. It will ever remain a monument of its author's industry and sagacity, and to him the position of the father or founder of this division of sanitary medical science is most justly accorded.

The wish expressed by Ramazzini in his preface, that his work might serve as a stimulus to other physicians to further pursue the subject he had so well introduced, was speedily realised. In each European State successive writers referred to his treatise, and supplemented its facts by others derived from their own research, though they did not emulate the old Italian by collecting facts in a systematic treatise.

English writers did not take a foremost place in developing the new subject. Dr. Buchan, in his long famous *Domestic Medicine*, gave a brief outline of Ramazzini's work. In 1703 Dr. Huxham produced his account of Devonshire colic, the true cause of which was not long after elucidated by Sir George Baker. We have reason to be proud of Mr. C. Turner Thackrah's treatise *On the Effects of*

Arts, Trades, and Professions, and of Civic States and Habits of Living, on Health and Longevity, published about the same time with Patissier's (1822) *Traité des Maladies des Artisans.* This latter book consisted of a *résumé* of Ramazzini's work, accompanied by comments and additional facts. A second edition of Thackrah's volume was called for in 1832, wherein 120 employments not previously examined were included. This treatise was no mere reproduction of the Italian physician's work, but was the result, largely, of the author's own observations on trades and their influence upon health. It will ever be a highly valuable book for reference, and very instructive on many matters it deals with; it fails, however, to represent the true state of things at the present time, when the growth of machinery, the advance of chemical science, and the enormous changes that have ensued among factory-workers and in factories, have transformed the character of almost every known industry. In France and Germany the subject at once took its place in the domain of medical research, and during the present century has had its area greatly extended by a numerous band of observers—far too numerous to designate by name. Among the more important works upon it of German origin are those of Dr. A. C. L. Halfort and of Dr. Ludwig Hirt. The former appeared in 1845, with the title of *Enstehung, Verlauf und Behandlung der Krankheiten der Künstler und Gewerbteibenden*; the latter in 1871, with that of *Die Krankheiten der Arbeiter.* In 1875, and again in 1878, two supplementary parts were published by Hirt, the last being devoted to surgical lesions consequent on occupation. The treatise is to be regarded as a complete standard work on trade-diseases at large. Its value is increased by a copious bibliography appended to each chapter. It is no compilation, however, for it bears throughout evidence of the author's original investigation respecting the principal employments noticed, and is not likely to be surpassed for fulness of detail. Nevertheless, in this present era of industrial progress, many of its details of manufacture are becoming obsolete, and its statistics less in value.

In 1882 an encyclopædic publication, with the title, *Handbuch der Hygiene und der Gewerbekrankheiten*, was brought out under the able editorship of Professor H. von Ziemssen, of which the section devoted to Trade Diseases was the joint production of Dr. Hirt and Dr. G. Merkel. This may be regarded as a compendium of Hirt's large treatise, with emendations and additions by Merkel.

The seventeenth volume of Ziemssen's *Cyclopædia of the Practice of Medicine* is occupied with Toxicology, and many trade maladies are incidentally described. To this series of volumes were added, as

supplementary, two others *On Hygiene and Public Health*, under the same editorship; one of them containing an excellent outline of industrial disorders, from the pen of Dr. Roger S. Tracey, of New York.

The French press has been even more fertile of works on this division of medicine. In each of the large Dictionaries of Medicine are to be found articles upon most occupations and trade materials. But besides, there are the special works on Hygiene by Tardieu, Vernois' treatise, *Traité Pratique d'Hygiène Industrielle et Administrative*, which appeared in 1860, and Dr. Michel Lévy's very complete work, *Traité d'Hygiène Publique et Privée*, which reached a sixth edition in 1879. The topic of diseases of occupations occupies the sixth chapter of this latter extended treatise; but the author speaks less from personal knowledge of these matters than of the hygiene of the army and navy.

The most useful French volume, and not deterrent by its bulk, is that by Professor Alexandre Layet on *Hygiène des Professions et des Industries*, published in 1875. It is a well-arranged and digested production, exhibiting a personal knowledge of the matters treated, and an excellent acquaintance with the literature of the subject. In his desire to represent fully the ascertained facts relative to industrial diseases, he quotes somewhat critically from previous authors, without indicating that the processes described by them have been set aside in favour of others to which the same evils do not attach.

Lastly, French physicians have furnished a complete storehouse of facts in that most useful periodical, the *Annales d'Hygiène Publique et de Médecine légale*. In this publication are to be found numerous contributions from MM. Tardieu, Delpech, Chevallier, Brouardel, and many other well-known hygienic writers. Several of them consist of reports on trade diseases that have been especially examined by their respective authors at the desire of the Government.

Since Thackrah published his book, no other systematic treatise has appeared in this country. This seems extraordinary, and not creditable to English medicine, when it is remembered that no country equals our own in the number and extent of its manufactures. Not that the subject has been entirely lost sight of,—for it has been briefly treated of in the late Dr. E. A. Parkes' standard work on Hygiene, and short chapters or paragraphs upon it are to be found in most manuals of hygiene and public medicine, almost all of them merely reiterating facts noted in Dr. Parkes' volume.

With respect to particular occupations, most valuable matter has been contributed by several physicians, having special knowledge.

We have admirable accounts of the processes pursued and the diseases resulting therefrom in the Essays on the diseases of 'grinders,' by Drs. Calvert Holland and J. C. Hall, both Sheffield practitioners. Again, the conditions of labour and their consequences, with copious statistics concerning linen workers, were well detailed by the late Dr. Charles Purdon of Belfast. In addition, several gentlemen resident in mining districts have contributed papers on the labour and maladies of miners. Moreover, we have the advantage of a wider survey of industrial diseases and of extended personal inquiry recounted in a course of lectures delivered at the Society of Arts, of London, in 1876, by my old friend Dr. B. W. Richardson. The same writer contributed to *The Medical Times* (1864) a series of papers on the manufacturing towns of the kingdom, rich in social and sanitary statistics. We are further indebted to his prolific pen for a capital little handbook *On Health and Occupation*, which appeared as one of a series of manuals issued by the Society for Promoting Christian Knowledge, in 1879, and for a brief notice of the subject in his volume on *Diseases of Modern Life* that appeared in 1876.

The statistical side of the subject has received a fair share of attention. The *Journals* of the Statistical Society of London contain articles of value, foremost among which are the papers written by the late Dr. Augustus Guy, who for many years occupied a prominent place among sanitarians. Of non-medical statisticians we have brilliant examples in the case of the late G. P. Neison and of his son. The former produced a standard work on *Vital Statistics*, which has gone through two or three editions. Mr. Ratcliffe and Mr. Harden, also, have both made painstaking examinations and analyses of the mortality and sickness returns of large Friendly Societies to show the relative amount of sickness and death, and also the value of life, in most occupations.

The subject is likewise illustrated by the reports made from time to time recording the experience of Life Assurance Societies. The courtesy of Dr. Muirhead, of Edinburgh, the chief medical officer of the Scottish Widows' Society, has put me in possession of a series of tables well worked out to show the diseases producing death among its assurers over a number of years. And I am indebted to the Secretary of the Clergy Mutual Association, Mr. Hodgson, for a copy of the society's mortality experience, extending over a period of fifty-eight years, to which is appended an excellent commentary on the medical history of the office by the late Dr. W. H. Stone.

I now come to most important materials derived from officials attached to one or other of the departments of Government, or who

have acted on special commissions constituted by the Houses of Parliament.

The oldest attempt to curtail or control the licence and liberty of manufacturers and of their work-people originated from several Parliamentary commissions and committees, after the conclusion of the great European war at the commencement of this century. Early legislation was little more than tentative, but by successive acts of Parliament a comprehensive factory system has been brought into existence, together with an able staff of inspectors for its administration, under the leadership of Mr. Alexander Redgrave, C.B., whose retirement, after many years of vigorous and efficient service, we have reason to regret.

Complementary to factory legislation followed the Mining Acts, aiming primarily at the protection of miners from accidents, and the curtailment of juvenile labour, and in only a secondary manner at the enforcement of truly sanitary measures.

The reports of the factory and mining inspectors, but especially the former, are replete with information concerning the processes and effects of occupations upon health. The Children's Employment Commission likewise contributed extensively to our knowledge of industrial diseases.

To no one are we so deeply indebted for initiating investigations into the prevalence of trade maladies and their causes as to Sir John Simon. Beginning with them at the time he occupied the post of medical officer of the Privy Council, he continued to push them during the many years he occupied the post of chief of the Medical Department of the Local Government Board, and called to his aid the staff of skilled assistants who have worthily followed in the course he struck out. One of his earliest and ablest workers was Dr. Headlam Greenhow, who carried out a most painstaking examination of the vital statistics of the kingdom, of which the results were published in a Blue Book in 1858. To the same observer we are indebted for an inquiry respecting the prevalence of chest diseases in the principal manufactures of the kingdom and its causes, as recorded in *Third Report of the Medical Officer of Privy Council,* printed in 1861. On being transferred to the medical department of the Local Government Board, the same wise course was zealously followed up by Mr. Simon, and several eminent physicians, specially skilled in making sanitary researches, were sent out by him from time to time to institute investigations respecting certain selected trades and manufactures. Besides Dr. Greenhow were such men as Drs. Augustus Guy, Edward Smith, Whiteley, Bristowe and Ord, and G. Buchanan.

The plan so judiciously started by Sir John Simon has been carried on by his able successors in office, and various most valuable contributions have been made on diseases connected with employment by Dr. Russell of Glasgow, the late Mr. Spear, Dr. Parsons, and Dr. Edward Ballard. The last-named has presented an exhaustive report on most of the effluvium nuisances attending the trades of the country, besides other matters.

It is universally known how marvellously the late Dr. William Farr utilised the mortality returns to illustrate the state of health of the people and the effects of employments. His successor in the office of medical officer of the department, Dr. W. Ogle, is equally energetic and successful in the same work, and his supplement to the report of the Registrar-General has conveyed a vast amount of statistical and general information respecting the health conditions and mortality of trades.

Of the other public departments, those controlling the Army and Navy stand foremost in the completeness of their reports on the health of the two services. The kindness of Dr. Dickson, the principal medical officer of Customs, has enabled me to present an interesting summary of the health conditions of that service, and that of Dr. Gordon Brown, the chief medical officer of the City of London Police, has furnished me with admirable statistical facts respecting the sanitary state of that force. Again, Mr. Timothy Holmes, formerly the head of its medical department, has, in his great kindness, lent me the same service with regard to the Metropolitan Police Force. Of the Post Office employés I could have presented no account,—as the authorities withhold information,—had it not been for the kindness of a friend who supplied me with reports of the great sick benefit club connected with the department.

Agitation arising in trades at large, or in particular ones, has helped to bring to light many facts relative to industrial maladies. An example of the kind exists in the reports of the 'Children's Employment Commission,' which examined into the principal trades of the country; and another, having a more limited scope, reveals to us the history of cotton 'sizing,' which was found to be highly detrimental to the health of weavers.

One source of the information sought might fairly be looked for in the reports issued by the medical officers of health in the various towns; but so far as these documents have fallen under my notice, they have proved barren. It is, to my mind, an indication that the importance of noting industrial diseases, and estimating their influence on the public health and mortality, has not as yet been recognised.

The reports of Dr. Sinclair White, formerly medical officer of health at Sheffield, constituted a noteworthy exception. He presented special memoranda on the health of Sheffield artisans. His successor in that town, Dr. Theodore Thomson, followed his example during the time he held office.

I do not lose sight of the existence of very numerous brief communications concerning special trade operations on human health and life, to be found in the Transactions of medical societies and in the medical journals.

CHAPTER II

ON THE CONDITIONS AND CIRCUMSTANCES OF LABOUR

Rightly to estimate the effects of an employment upon the health of those engaged in it, it is essential to understand the conditions and circumstances connected with it, and these are found to be almost as numerous as are occupations themselves.

The best division for the present purpose is into (1) *incidental,* or apparently essential, and (2) *accidental,* or non-essential conditions.[1]

On the whole, the latter must be regarded as the more numerous, and not infrequently, more active. Indoor labour expresses an incident, or series of incidents, yet its effects on health will be varied exceedingly by accidental circumstances. Exposure to heat is an incident of the occupation of glass-workers and furnacemen, but a host of accidental conditions concur with it in affecting health. And the same holds true of every employment.

The effect of labour will be influenced likewise by moral and social, as well as by physical, surroundings.

Labour in General.

The remarks to follow on this matter will be rightly prefaced by enunciating, as a general law, that the conditions of

[1] In the Milroy Lectures (1889), I employed the terms intrinsic or essential, and extrinsic or non-essential, to express this division. But further consideration disposes me to prefer the words 'incidental' and 'accidental,' as more elastic in meaning. For the history of manufacture abounds with illustrations of material changes in the conditions under which the same results are now attained, as contrasted with the past; so that circumstances which formerly appeared essential to, or inseparable from, a given employment, have ceased to be so. And this transformation or subversion of apparently intrinsic conditions of work, is perpetually going forward, and forbids making absolute distinctions, especially in the case of manufacturing processes.

an employment govern the question of the age, the sex, and the general physique, as well as the prevailing health of the employed, and their status in society.

The idea of labour implies, in some shape and degree, exertion of mental or of physical power, or of the two together; and its results to health will vary not only in relation to the amount of exertion put forth, but also according to its continuance. Its effects, again, are increased or mitigated by collateral circumstances attending the labour itself, or inherent in the individual employed, or connected with his diet, his habits of life, and his sanitary surroundings.

In the more laborious occupations incompetency for work will happen at an earlier period of life or from slighter ailments, and necessitate cessation from labour, either permanently or for a time. As a consequence, fluctuations among the workmen in such trades occur in a higher proportion from sickness, and make their impress upon vital statistics.

On this subject, Dr. W. Ogle's remarks, in the Forty-Fifth Annual Report of the Registrar-General, p. 23, demand attention. He says:—

> 'Even in those industries where no excessive amount of muscular strength is required, there must nevertheless be always a certain line below which continuance in the business becomes an impossibility. The weaker individuals, and those whose health is failing them, are thus being constantly drafted out of each industrial occupation, and especially out of those which require much vigour; and the consequence is that the death-rates in these latter occupations are unfairly lowered, as compared with the death-rates among those persons who are returned as having no occupation at all.'

Of such individuals, a considerable proportion drift into the miscellaneous class of toilers, comprised under the headings of general labourers, messengers, street-sellers, whose mortality stands the highest in Dr. Ogle's list of occupations.

The amount of labour to be accounted excessive is distinctly a relative quantity, dependent primarily on the health, the dietary, and the physical powers of an individual. And as the ability to undertake any task is, so far as adults are concerned, a matter of personal judgment and choice, it

follows that laborious occupations will, as a rule, be avoided by weaklings, and be taken up by the more robust members of the community. Whence it happens that such employments present a lower rate of mortality than those of a lighter kind. But this fact by itself does not warrant the inference that the heavier forms of labour are necessarily the more healthy. For, as Dr. Ogle observes (*loc. cit.*, p. 23), 'such industries are in fact carried on by a body of comparatively picked men; stronger in the beginning, and maintained at a high level by the continual drafting out of those whose strength falls below the mark.'

Mental labour, in its severer forms, is illustrated in the case of mathematicians, physicists, engineers, literary people, and members of the learned professions; but it also belongs in various degrees to all directors and superintendents of the common toilers.

If the ratio of lunatics in the various occupations be held to indicate the extent of mental strain, then the liberal profession suffer most, for, according to M. Lévy's table,[1] a higher percentage of insanity prevails among them, than any other calling, except the military and naval services. That these services figure for so high a ratio in asylum statistics, M. Lévy would account for by the fact of the early transfer of soldiers and sailors to insane hospitals; whereas civilians are allowed to remain at large altogether, or else their removal is delayed. He has taken for data the return of public asylums, and calculates that 199 naval and military men per 100,000 are lunatics; 177 members of the liberal professions, 155 domestic servants and day labourers, 66 mechanics, 42 commercial men, and 77 people following miscellaneous trades and non-recorded occupations. He supplements these assertions by some relative ratios, indicating that artists head the list in the professional group, and that in sequence follow members of the legal profession, clergymen, and doctors, literary men, and, bringing up the rear, public functionaries.

Physical exertion, carried to excess, becomes a cause of disease. The whole frame, or only a part or organ, may participate in the excess; and its injurious effects will be governed by sex and age, and by the whole number of

[1] *Op. cit.*, vol. ii. p. 751.

circumstances connected with the callings followed. Again, excessive exertion may operate either over a long period and produce its ill-results slowly, or be sudden and severe. Examples of overtax of the physical frame are not uncommon among soldiers in long marches, among general servants and hotel waiters overworked for long hours, and among many divisions of the class designated labourers. And here, I would remark in passing, that when such people are seized by some definite lesion, attention is so completely attracted to it, that the antecedent overtoil laying the foundation for the malady is apt to be overlooked.

Illustrations of over-exercise of a portion of the body, or of one organ or tissue, are to be seen in the many deformities that spring from it. At the same time, it is true that not a few deformities are compensatory. Spinal curvatures may be quoted as examples. Over-use of one limb disturbs the harmony of the body in form and function; for it encourages overgrowth of one portion at the expense of another. Over-strain is in its nature inseparable from over-use, but its consequences may be more serious when its action is violent and sudden, as happens with men lifting heavy weights, or wielding heavy hammers.

Bodily deformities, slowly induced by unequal exercise of parts, are witnessed in the bent backs of nailmakers and porters, in the twisted form and unequal shoulders of young nurse-maids, and in the inequality of shoulder elevation present in the case of 'throwers,' and of turners in the pottery manufacture. Such abnormalities, to a great extent, have a special significance, and may be called 'trade-marks.'[1]

Again, over-use declares itself in the production of those peculiar muscular spasms known as cramp, affecting writers, clerks, and players on musical instruments, such as the violin and piano.

Akin to over-use is prolonged friction, which causes callosities, distended bursæ, aponeurotic contractions, etc., the mention of which suffices. It is worth while to note that excessive use is not peculiar to active bodily employment, but

[1] M. Vernois has contributed an exhaustive treatise on this subject, entitled *De la main des ouvriers et des Artisans au point de vue de l'Hygiène et de la Médecine légale.*

prevails in many so-called sedentary occupations—the excess falling upon some part or organ.

The evils of excessive use of internal organs are seen in the sore throat of public speakers, the asthmatic chests of players upon wind instruments, and the hæmoptysis consequent on excess in singing. Examples of the same condition, in respect of the special senses, occur in the account of many occupations, and are collected in a special chapter on overuse and overstrain. A general rule, applicable to over-exertion in all its forms, is, that the mischief attending it is greater and more serious when the frame is young and immature, and, likewise, when it is debilitated by some constitutional malady. Hence the wisdom of the State in denying work to the very young, and to all who exhibit bodily infirmity incapacitating them for the work required at their hands.

Indoor and outdoor employment.—The circumstance whether an occupation is of *outdoor*, or of *indoor character*, is one of primary significance. Looked at from all sides, outdoor labour is more healthy than indoor. Statistics make it quite clear that those engaged in agriculture head the scale in life-value. Seamen, again, who practically lead outdoor lives, although subjected to wet, to storms and tempests, and great vicissitudes of temperature, are remarkable for their high state of health. The evils of dusty trades are materially lessened when they are pursued in the open air, or in sheds only partially enclosed. It thus happens with the granite-workers in Aberdeen and neighbourhood.

Writers on the grinders' asthma, as seen in Sheffield, state that in former times, when the men worked in rude sheds, placed on the banks of streams with the object of securing water-power, their health was better, though they were exposed to winds, and draughts, and cold, than in subsequent years, when steam-power came into use, and they were transferred to enclosed workshops.

Hannover also states that, in Copenhagen, where the climate in winter is very severe, the mortality statistics prove that phthisis is less common among outdoor labourers. Lévy confirms this statement, and asserts that they suffer only one half the mortality from that malady of indoor artisans.

The majority of indoor industries have the disadvantage of presenting little variety in the methods of working, especially in manufactories, where there is great monotony in whatever branch of employment is pursued, and the workman counts for little else than an appendage to a machine. Day by day the worker is called upon to do the same mechanical act, without feeling a personal interest in the result of his labour; for this is no product of his thinking or inventive faculty, but pre-determined by mechanical contrivances; and day by day he continues at his task, wearisome to the spirit, earning a fixed rate of payment, sufficient, usually, to supply his animal requirements, but holding out small prospect of escape from toil whilst he can perform it, or of a coming period of competency and enjoyment.

In all respects outdoor labour has a distinct advantage over indoor employment. It secures free air, free movement, and freedom from monotony, and likewise gives the benefit of wider intercourse with our fellow-men.

Sedentary labour is a condition of a host of industrial pursuits. Etymologically, it means labour carried on in the sitting posture, but convenience sanctions the sacrifice of this primary meaning, and the application of the term to all forms of work demanding little muscular activity, and almost always of an indoor character. In fact, sedentary work might be defined in numerous instances, as occupation with insufficient physical exercise for the whole body, and performed indoors. In some of its varieties the movements required are very insignificant, as in the occupation of clerks, engravers, artists, tailors, and milliners. In others, as in the case of turners, needlemakers, of persons attending on textile and other machines, and fitters occupied in several departments of their trade, more or less active motion of the hands, arms, or legs, is requisite. But the truly sedentary callings merge, by easy gradations, into employments of which muscular activity is an important element. In the large group of shopkeepers and shopmen, there is a wide diversity in the amount of bodily exercise. Retail business, as conducted in a quiet country town, is quite a different thing from the same occupation carried on in the metropolis. The accom-

panying circumstances of sedentary work often exercise a more profound influence upon health than does the nature of the occupation itself. Of such circumstances, the most important, perhaps, is the attitude required. In the instance of clerks, of watchmakers, jewellers, and engravers, and of many other artisans, a stooping position, with the arms pressed against the thorax, is the rule; involving impediment to chest movements, and usually, also, pressure upon the epigastric region detrimental to the gastric functions.

The consequences to health of sedentary labour being so copiously written about in medical treatises, and so well understood generally, no detailed account of them is here required. The want of exercise of the body induces general torpidity of function; reduces lung capacity and respiratory completeness, and the activity of the abdominal muscles which aid both respiration and the functions of the digestive organs. Hence the proclivity to venous stusis, particularly in the pelvis and lower extremities and in the rectal vessels, with the production of constipation and piles, and in women, of menstrual irregularities. Add to these, disorders of digestion in their multiform shape, debilitated muscular power, and a low vitality and vigour generally.

When, again, insufficient muscular activity is associated with almost constant standing, the increased difficulty to the return of the blood from the lower limbs is the most prominent feature, and productive of varicose veins and ulcers, of thickened knee- and ankle-joints; and where the attitude has been assumed in childhood, of flat feet and distorted ankles.

The late Dr. A. Guy made a special analysis of the official mortality tables, in order to discover the 'Influence of Employments upon Health,' and presented the results in a contribution to the Statistical Society of London, in 1843. The following conclusions are abstracted from it:—

'The ratio of cases of pulmonary consumption to those of all other diseases, is highest where the amount of exertion is least, and lowest where it is greatest; and the intermediate degree of exertion presents an intermediate ratio. The age at which pulmonary consumption makes its attack is earlier in employments requiring little exertion, than in those requiring more, and in those requiring moderate exer-

tion than in those demanding great effort. The average age of death is lowest where there is least exertion, but highest where the exertion is intermediate between the two extremes. The class of outdoor occupations requiring moderate exertion, presents a higher percentage proportion of deaths under forty, and a corresponding excess of young men. Sedentary employments, and those requiring little exertion, are more unfavourable to adult and middle age, but more favourable to old age; on the other hand, employments requiring great exertion are unfavourable to youth and longevity, but favourable to middle age. Employments requiring little exertion prove fatal, by inducing an excess of cases of pulmonary consumption early in life; those requiring great exertion, by occasioning other diseases of the air-passages and lungs, towards the commencement of old age.'

Mr. Neison's conclusions are in agreement with the foregoing (*Contributions to Vital Statistics*, third edition, 1857). At p. 457 he writes:—

'It will be observed that, in regard to indoor occupations, the expectation of life differs little until after age forty, and then there is a decided difference in favour of the occupations requiring great exercise; but in respect to the outdoor occupations, the section requiring little exercise exhibits a most remarkable inferiority in the value of life. The results are certainly very striking, and are calculated to throw much light on many obscure and vexed questions connected with inquiries made into the sanitary state of our large towns. These results are strongly corroborative of the opinion that differences in occupations of the people have a greater influence on the mortality than any peculiarity due to differences in locality, the drainage of towns, or the ventilation of dwellings. The expectation of life in the section of outdoor occupations requiring little exercise is not only remarkably below that of the outdoor occupations with great exercise, but is actually less than either of the indoor sections, and is even 20 per cent. less than the indoor section with little labour. An extension of this branch of the inquiry would probably show that, concomitant with outdoor labour requiring little exercise, there may be peculiarities of personal habits not essential to the occupation itself, which may to some extent account for the high rate of mortality.' At p. 462, after an analysis of returns of sickness among women, Mr. Neison arrives at the conclusion that, until above sixty, the sickness of both active and sedentary female occupations "is in excess of that of the males for the whole of England and Wales;" and further, that sickness in the sedentary employments is

greatly in excess of that in others. In fine, Mr. Neison assigns a higher importance to the amount of physical exercise connected with employment, as a factor influencing the value of life, than to sanitary conditions, as commonly understood. "It is not to be expected" (he says, on p. 468) "that any arrangements whatever as to the drainage and planning of streets are likely to add to the longevity of a tailor; but if it were possible to give to his frame the physical exercises of a ploughman, 20 per cent. would be added to the duration of his life. Neither is it to be thought that the plumber, painter, and glazier is to be relieved from the poison of the metallic emanations to which he is exposed; nor that the clerk can inhale the fresh air and indulge in those exercises necessary to develop his physical con, stitution, while he follows the drudgeries of the counting-house. It is an aggregation of these and other employments similarly constitutioned which make up the excessive mortality of our large towns (as compared with that of the country) independent of any local influence on health."'

These remarks on the contrasts presented between indoor and outdoor occupations may be well summarised, by quoting the general conclusion or law laid down by Dr. Greenhow, viz., that 'in proportion as the male and female populations are severally attracted to indoor branches of industry, in such proportion, other things being equal, their respective death-rates by phthisis are increased.'[1]

In this quotation phthisis is taken as the index of the effect, at large, flowing from indoor occupation with its many collateral circumstances. The more thorough our investigations of the consequences of sedentary work within doors, the stronger grows the impression of the potency of such work to sap the vital powers and render the body an easier prey to disease. Besides its influence for evil, usually strengthened by association with insanitary surroundings of residence and occupation. In an indirect fashion, this making for evil of indoor sedentary work is proved by the great good effected by physical exercises directed to the undoing of its effects, as seen in the excellent returns of the 'Polytechnic Physical Development Society of London,' under the direction of Dr. Hambleton.

Employment under ground is an incident of labour

[1] *Public Health Reports*, by John Simon, C.B., F.R.S., etc., vol. i. p. 454.

occurring in the working of metalliferous and coal mines. It is necessarily associated with the absence of daylight, and is attended by disadvantages in the shape of heated and close air, wanting normal respiratory qualities, abounding with dust and frequently with moisture, and pervaded by noxious gases. While it must be admitted that work in the dark, when long continued, exerts some effects on the general health and vigour, on the blood-making and nutritive functions; and that miners in general do not exhibit the appearance of robust health; yet it is true that darkness alone yields vastly in importance to those other circumstances of underground work just now enumerated. Dr. Roberts, of Festiniog, has shown that the slate-getters or quarriers, who in that district work under ground, suffer less from their calling than the slate-dressers who work in daylight in shops on the surface,—a fact explicable by reason of the greater exposure of the latter to dust.

Associated and solitary labour in their relations to health stand on the borderland between incidental and accidental conditions. For instance, weaving may be carried on by a solitary worker; but at the present day it is almost entirely a variety of associated labour pursued in factories. Each form has its own peculiar health characters. Those employed in a common workshop or factory are subjected to whatever sanitary arrangements exist within it. These may be better or worse than those at the disposal of the domestic worker. He is independent and free as to what he does; may vary his hours of work and meals; is not exposed to the noises of a multitude of machines, nor injured by proximity, as frequently happens, to processes of manufacture more damaging to health than his own. However, solitary labour has its drawbacks. It must be regarded as adverse to healthy mental activity. In the majority of instances the work itself is monotonous, or even dreary; and possibly also accompanied by discomfort, or circumstances actually unfavourable to healthy development and conformation. It is a melancholy picture to see a weaver sitting solitarily the whole day long at his loom; or a cobbler seated day after day at his 'last,' in a constrained attitude prejudicial to healthy function both of the chest and abdomen.

On the other hand, associated labour has many peculiarities unfavourable to human well-being. One such, though not indeed confined to it, is the aversion or actual refusal of the employed to depart from customary methods of work, or from established usages, even where their disadvantages or their folly be demonstrable. This course of action is often fostered and maintained by the bye-laws of trade societies. And experience among artisans proves that, in too many cases, even when they recognise the folly of them, they will persevere in practices inimical to their health and comfort. There is a prevalent prejudice among workmen against anything new, or whatever requires of them pains to learn and render useful or efficient, or what makes them appear singular by its adoption. For example, workers in dusty rooms almost universally reject the wearing of respirators calculated to prevent the inhalation of dust, in spite of their knowledge of the serious consequences of neglect. The jeer of their fellow-operatives that they have their 'muzzles' on outweighs the teachings of common sense and experience. In like manner, loose and fluffy articles of dress, the appendages of vanity, will not be laid aside, notwithstanding that it is clear to themselves that they cause accumulation of dust on the person, or increase liability to accident from machinery.

A lesser disadvantage of associated labour is the not infrequent subjugation of the many to the wilfulness of the few. This, ever and anon, occurs in the matter of ventilation. One workman, for good or bad reasons, opposes all entry of fresh air from without, and makes his opposition effective against the wishes of most of his fellow-shopmen.

Other examples to the same effect might be cited, all arising from the fact that in associated labour the individual loses the freedom of individuality.

There is yet another incident more potent in associated than in domestic labour, viz., the force of example in encouraging habits of intemperance, originating in trade usages. Such, for instance, is the entry of a new hand in the shop, or the occurrence of any marked social or domestic event in the life of a fellow-workman, or, in short, of any departure from the routine of business. These trivial occurrences are made excuses for drinking and treating, and few are those

who have the moral courage to resist the 'customs of the trade.'

These customs, again, are seen in activity in other directions; for instance, in the matter of dress and of the construction of shops. Thus, in the business of butchers and fishmongers custom demands open shops, with consequent exposure to the weather. Again, in many employments the custom is to work in the shirt sleeves, and without proper protection to the chest. This practice is largely due to our insular notions of the respectability of cloth coats—particularly black ones—which, being inconvenient and burdensome during work, are cast aside. The sensible adoption of blouses, as worn on the Continent, would put an end to this absurd custom, to the advantage of the workman in health and pocket.

A further illustration of foolish custom in dress is seen among sailors, who seem to rejoice in the smallest amount of covering to neck and chest. Another, for which no adequate reason exists, is, in retail shops, the practice of prolonged standing,—a practice liable to cause injury, especially to women, and, unhappily, often made imperative. Nevertheless, in a considerable number of employments, long standing, or, in the majority of cases, the erect posture, with a certain amount of movement, is inevitable. Examples at once occur in the work of carpenters at the bench, of turners at the lathe, of earthenware pressers at their craft, and of a considerable proportion of the hands in textile manufactories. In these and many other occupations the nature of the business forbids a sitting position.

The *materials used* in an occupation are incidental conditions. They supply essential features for framing the distinctions between the different trades, and present health conditions of greater extent and potency than any others connected with employments.

Materials are either of poisonous or of innocent nature; but the latter may become injurious, owing to the operations to which they are subjected. This class of conditions will hereafter be examined in detail in connection with special occupations.

Machinery has largely to do with the health conditions

of labour. Its presence or absence determines, to a great extent, the character of the manufacturing processes, and many collateral circumstances of importance to health. Indeed, the introduction of machinery, moved by steam, gas, or electricity, into an occupation more or less revolutionises the operations heretofore belonging to it, and therewith its relations to the health of the employed.

The expansion of manufacture by the agency of machinery is the most remarkable feature of the present age; and every year the simple handicrafts are reduced in number, and profoundly modified in character. It leads to the extension of associated labour in factories, and to an astonishing subdivision of work. One result of this latter circumstance is an increased monotony of occupation. In the boot and shoe trade, for instance, whilst the machines in use deliver the workman from the cramped and unhealthy position enforced upon his forefathers, and from the chest pressure caused by the 'last,' they deprive him of whatever satisfaction might be felt in making and turning out entire a boot or shoe, and cause him to expend his technical ability in dreary monotony on making only one portion, or in stitching two parts together. He has ceased to be a shoemaker, and is converted into a 'closer,' or a maker of 'uppers,' or of some insignificant part of a shoe. The like lot has befallen tailors, who, instead of being called upon to make a garment, are reduced to producing only a ninth part of one, and this, too, by the agency of a machine which embodies the intelligence of the operation performed, leaving the artisan little else to do than to watch it.

In fact, it may be truly said of machinery, that it reduces those who use it to the position of a part of itself. The man is transformed, in a greater or less degree, into an accessory machine, and even in this humble position his utility is perpetually encroached upon by the invention of new automatic movements. Formerly, lads and women were needed to take off and to fold the impressions as they passed the newspaper printing presses; but now those presses are so contrived that they cast off, fold, and register the number of copies struck off. And, generally speaking, it may be asserted of machinery, that it calls for little or no brain exertion on the

part of those connected with its operations; it arouses no interest, and is wearisome by monotony. Machinery, consequently, has nothing in it to quicken or brighten the intelligence, though it may sharpen the sense of sight, and stimulate muscular activity in some one limited direction.

The preceding account of the influence of machinery upon health does not exhaust the subject. That some effects must follow upon the rapid whirling of machines and the noise produced, is a reasonable inference. The special senses so exposed are necessarily subjected to a species of strain or over-use. Those unaccustomed to machinery are dazed by its operations, and willingly escape from its presence; and those regularly occupied with it, in conducting and regulating its action, and in intently watching its output, can only do so at the expense of more or less wear and tear of nerve function, and, indeed, of the whole nervous system. Their fatigue is the fatigue of watching, not of working.

It is well worth the investigation of medical men living in factory towns,—where machinery exists on a large scale,—to determine how far the special senses are affected, particularly hearing, by the uproar and whirling attendant upon it. The deafness of boiler-makers and smiths, as a consequence of their noisy trades, is well known; and it is difficult to believe that the workers in a huge weaving-shed, where speech is of necessity replaced by shouting in the ear of the person spoken to, escape with hearing unblunted. Another problem for the same inquirers is, to what extent nervous disorders prevail in the population relatively to other places where machinery is in little use.

Machinery is, unfortunately, sadly prolific of accidents. A considerable proportion of them is due to carelessness on the part of the operatives themselves, who, from familiarity with it, grow indifferent to necessary precautions.

One great object of the Factory Acts is to enforce precautions against accidents from machinery; hence they require a return to be made to the Chief Inspector, of all casualties which cause death, or which disable a workman from pursuing his occupation for two days.

Some conception may be formed of the frequency of factory accidents, by a quotation from a recent report of

the Chief Inspector. For the twelve months, ending 31st October 1889, 7967 accidents were reported. Of these, as many as 443 were fatal.

In this place it is not the purpose to enlarge on their causes, but attention must be called to the fact that a high ratio of casualties in a calling reduces that of the deaths from ordinary diseases, as displayed in mortality tables, and, therefore, in equal proportions, enhances its apparent healthiness.

It may be accepted as a general truth that, in the case of employments acknowledged as hazardous, there is a singular recklessness of conduct with regard to health and life. Moral influences will bear fruit in physical consequences; so that even where an occupation presents in itself no conditions positively injurious to bodily health, it may indirectly, by its moral and social surroundings, prove to be so.

Work in mines is of a rough character, and its surroundings also are not calculated to quicken the sentiment of self-respect, or even that of self-preservation. Miners, as a class, exhibit a strange amount of recklessness in the face of danger. So in the case of men engaged in the lowest callings—*e.g.* scavengers and sewerage labourers, there is a parallel indifference to their own well-being. Their sensibilities are blunted, and require strong impressions to arouse them.

As remarked at the outset of this chapter, the division of the conditions of labour into incidental and accidental is, to a considerable degree, arbitrary and artificial. The foregoing observations supply proof of the proposition, for in the attempt to elucidate incidental circumstances, many belonging to the accidental category have crept in. The latter now require special examination.

Accidental and Collateral Conditions.

First among these may be placed the *social status* of an employment, coupled with the degree of physical labour required and the wages to be earned. These are the material elements concerned in *the choice of a calling*. But, supplementary to them, hereditary influence has to be taken into the reckoning. At times, in fact, it overrules all other

considerations. This is especially noticeable among Eastern nations, and in olden times obtained extensively in our own land. It has both its advantages and disadvantages. On the one hand, it tends to technical perfection in the manufactured article, and to the development of greater aptitude of manipulation. On the other, its effect is to reduce the artisan to a mere copyist,—a sort of machine, reproducing old patterns and methods, and to benumb originality. It has a further tendency to perpetuate physical defects and disorders engendered by the occupation.

Choice of a Trade.—To a certain extent the choice of a trade is a matter of natural selection. The sense of fitness or unfitness will carry some weight, both with parents and the individual. Unhappily, mental and constitutional fitness is often allowed to count for less than the social position and profit to be got from a profession or trade.

There are many employments that especially recommend themselves to the less robust and to those indisposed to bodily toil. They are esteemed light businesses, and if the reputation of their being 'genteel' also attaches to them, they become so much the more attractive. For these occupations the principal candidates are to be found among women and girls, and the weaker members of the male sex. The nature of an occupation has, therefore, a material influence on the class of people entering it. Thus, if it attracts a large proportion of feeble lives by reason of its affording easy work, it will, as a matter of course, present a higher ratio of mortality and a shorter duration of life than is rightly chargeable to it,—*quoad* its industrial features. The health and mortality statistics of clerks may be adduced in illustration.

The selection of work not physically laborious threatens, in the present day, to give rise to a problem of great social and political importance. A false and mischievous notion is abroad, that there is something degrading in manual labour, and that it is much more genteel on the part of youths of both sexes to aim at becoming clerks, or shop assistants, or milliners and dressmakers, or governesses, or schoolmistresses.

The prospect of gain is, without doubt, the most powerful

factor in the selection of a business. The liberal professions allure candidates both by the social position they offer, as well as by the gilded baits they hold out to the many, to be secured, alas! by the very few. In various other occupations the social element is of weight in determining the choice. Yet, after all, the wages to be earned, or the business profits to be realised, are the chief considerations, for upon them depend the possibility of acquiring a comfortable position in the community, and the requisites for health and enjoyment. Where wages and profits are low, indifferent living-accommodation, shortness of food, and the depressing influence of poverty follow as consequences, with their attendant evils of infirm health and shortened days. Unfortunately a reverse state of things cannot be always predicated where wages are good. Improvidence, ignorance, and evil courses intervene too often, to negative the advantages derivable from sufficient earnings.

Another fact is, that large wages have to be given in various offensive, unhealthy, and dangerous trades, as an inducement to workmen to engage in them. And, as may be supposed, those attracted to them belong chiefly to the class of reckless, broken-down characters found in the lower stratum of society, who are willing to lead a 'short and merry life.' For experience shows, with regard to this grade of labourers, that the obnoxious work they carry on, coupled with the possession of means for self-indulgence, operates as an inducement to intemperance, vicious habits, and neglect of home conditions of cleanliness, comfort, and health. Examples in illustration are found among workmen exposed to high temperatures and to noxious dust and vapours—among men occupied in the making of chloride of lime, and the male and female workers engaged in the manufacture of white lead.

Apart, however, from its wage-producing power, each occupation, as already noted, has allotted to it its own social status. If the character of men following a calling makes its impress on the health-conditions of that business, so, on the other hand, does the position in society assigned to an occupation affect the *morale* of its followers, and react indirectly on their sanitary status. There is a wonderful

sensitiveness among tradespeople as to their relative position in society; and the prevailing accepted rules regarding it are not the outcome of any rational principle. Some almost necessarily consign their followers to a low scale, such, for example, as the occupation of scavengers, or of those working in many disgusting trades, and it has pleased society to allot chimney-sweeps a very inferior position. All such persons 'of low degree' have not only to put up with the indignity of their caste, but also to be, in a large measure, excluded from the beneficial contact of more favoured mortals. Certain writers who have especially occupied themselves with the relations between employments and the moral condition, have come to the conclusion that trades of an indoor nature, wanting in stimulation to healthy bodily exertion, and of an effeminate kind, are inimical to the moral well-being, and favour the growth of sensuality. Patissier quotes an essay by M. Cadet de Gassicourt to illustrate this fact. The action and reaction of the moral and material conditions of occupation admit of further illustration. Thus, in the case of unskilled labour it falls largely into the hands of people broken down morally and physically. This is seen in the heterogeneous body of workers represented by common labourers. Hence, too, it happens that unskilled labour contributes a very disturbing element in all investigations concerning the health-statistics of particular trades, as well as of populations, by reason of the incessant changes and migrations of those engaged in it. This is more observed in employments of inferior and rougher kinds, where no training to the work is needed, but only a certain measure of bodily strength. Almost the only considerations on the part of an unskilled workman are, what wages are to be got, and in how short a time. He is about equally useful in any craft, and can shift his quarters at discretion, and escape the attentions of the tax-collector, the policeman, and the statistician.

But even artisans who have attained skill in some small craft, such as lock and key, and small chain, and nail making, are likely to be an unsettled and poorly paid class, because such trades require little capital, and hence fall into the hands of small masters who have to meet severe com-

petition; as a result, the workmen wander from factory to factory as free lances, open to hire by any master who at the time has orders on hand and promises better pay. It may be accepted as a general fact, that where the occupation pursued is of a simple character, demanding no special technical training, the labourers engaged in it will be a changeable and nomadic body.

Constancy of Employment, or the reverse, is another condition of labour allied to that just named. An occupation that calls for technical skill and steady work, and that holds an important place in the category of necessary employments, will be conservative with regard to its employed. It possesses usually the advantage of offering better rewards for labour. On the contrary, there are numerous trades, especially those ruled by fashion and those concerned with the preparing and preserving of animal and vegetable substances—in a word, 'season trades,'—which are very fluctuating. A period of active operation is followed by one of stagnation, and occasionally one almost of extinction. And there are, besides, numerous branches of work which ever and anon drop out of the list of wage-producing employments, consequent on the introduction of machinery to replace hand-work.

Examples of decayed industries are seen in the once active metal button trade; and of fluctuating ones in the straw hat and the common hat and bonnet business, in the making of confectionery, and in bookbinding. In the last-named occupation a great redundancy of labour suitable to women and girls was brought about by the invention of stitching-machines served by motor-power. It has, moreover, periods of slackness, and as the wages to be earned are poor, those engaged in it are exposed from time to time to much misery.

An opposite side exists, especially in trades regulated by fashion. Instead of deficient work, an excessive demand for it at times arises, and thereupon follow overwork and excessive hours of work.

That the health of workers must suffer from fluctuations in one or the other direction, directly and indirectly, needs no demonstration.

Influence of Capital on the conditions of Labour.—The

influence of capital is small on most mechanical trades, but with respect to manufactures calling for machinery and a large outlay upon buildings and 'plant' generally, it affects materially the circumstances of labour, and the health of the labourers. Insufficient capital implies inability to compete with those who have enough, except by working at small gain, and by withholding expenditure upon appliances and materials of all sorts appropriate to the trade carried on. Hence originate many of the unhealthy and ill-built factories and workshops of the kingdom; defective in general arrangements and in space for healthy work; devoid of apparatus to remove dust, to prevent the discharge of smoke and of poisonous and noisome effluvia, and to supply a suitable temperature to the employed.

All this is so obvious that I feel it to be needless further to enlarge upon this topic, except to indicate that, in manufactories so circumstanced, the class of labourers employed will be of an inferior quality, who will add to the evils of omission, many of commission; whilst their masters will have recourse to shifts and expedients they would prefer to avoid.

The site of a Factory cannot fail to exercise an influence upon the health of those employed in it. With regard to its geographical situation and physical features it will partake the same sanitary qualities as the town wherein it is placed, or as the surrounding district. When, however, a comparison is to be made between two factory towns, or two mills, as to their relative hygienic state, the circumstance of the geographical and physical position of each must not be neglected; and it will be incumbent to note the site.

The location of a work-place, whether within or without a town, raises far more important considerations, inasmuch as the sanitary state of the town, and of its suburbs, and the adjoining country, are in all probability materially divergent. The late Dr. Charles Purdon, Certifying Surgeon for Belfast, in an elaborate statistical paper respecting the diseases of flaxworkers, showed that the hands employed in the mills more or less distant from the city, suffered less with sickness, and had a lower rate of mortality than those engaged in the factories situated within the city.

To the same effect are some observations by Dr. Greenhow.[1] Miners, he stated, residing a mile or two from their place of work, and having that distance to walk to and fro, and who combine some agricultural work with mining, suffer less from their calling than their fellows who reside contiguous to the mines.

The locality of the factory, of course, determines the place of residence of its work-people, and has an important bearing upon their state of health. They are subject to the same sanitary conditions as other inhabitants of the place. Therefore, to get an approximative idea of the comparative effects on health of the work pursued, and of the circumstances connected with residence, we need obtain a tolerably accurate account of the health statistics of the place, and of the working classes not engaged in the manufacture in question. Likewise, when it is sought to contrast the vital statistics of two towns, it is essential to discover their relative position hygienically, before the influence of the manufactures carried on in them severally can be estimated, or a comparison instituted. It is a most difficult problem to solve, especially in the case of an industrial town population, how far the diseases met with in it are town-made, and how far trade-made; the former almost always preponderate. Neglect in weighing these two factors vitiates most published statistics and statements, and accounts for the widely-divergent opinions expressed by different writers on trade maladies.

Of the influence of the sanitary state of the houses of the wage-earning classes, there is abundant proof. It is modified by the amount of money expended on the homes, by the habits of the workers themselves, and by the social position of the calling they follow.

Even between labourers engaged in a like trade, differences in this respect will exist. My observation convinces me that colliers living in agricultural districts have better homes in all respects than those dwelling in towns. This, there is little doubt, is owing, in part at least, to the fact that the collier in a town is beset by more temptations to neglect his home and family than his fellow-worker in the country. The latter has usually the further advantage of a plot of

[1] Third Report of the Medical Officer of the Privy Council, p. 133.

ground about his cottage, upon the cultivation of which he may spend his leisure.

Mr. W. T. Cox, in his valuable papers on the 'Diseases of Colliers in South Lancashire,'[1] after giving a deplorable picture of the social and moral condition of those workmen, thus writes:—

'A vast improvement in the social habits, and consequently in the health, of the operatives, would certainly be effected by their being provided with wholesome, well-ventilated, well-drained dwellings, and a cheap thorough water supply, where that great desideratum is deficient. In the coal-fields of South Wales and Monmouthshire, the colliers are generally resident in commodious cottages built by the masters in the neighbourhood of the works. It is to be regretted that this system is not generally adopted in Lancashire.'

Dr. W. Webb[2] attributes the fairly healthy state of the lead-miners of Derbyshire to their having healthy, clean, and comfortable abodes, with the addition, for the most part, of a plot of garden for cultivation and recreation.

Factory Construction exerts a powerful influence over the health of the employed. Under this heading may be conveniently grouped the construction of shops and places of labour of all sorts.

The details of construction have to be adapted to the form of manufacture or trade carried on, so that each leading occupation presents in its arrangements some peculiarity, and, in many instances, it is possible to recognise the nature of the employment pursued by the external features of a place of work. The presence or absence of machinery is a circumstance that regulates, to a great extent, the structural peculiarities; and, generally speaking, the more elaborate and costly the machinery, the more excellent the architecture. Thus, in textile works, machinery acquires its maximum of importance, and by its dimensions necessitates commodious shops, buildings of great size, and well-ordered arrangements, to facilitate the performance of the mutually dependent series of operations carried on. Hence it is that cotton, worsted, silk, and linen mills present palatial characters unequalled in any other branch of manufacture.

[1] *British Medical Journal*, July 1857, p. 580.
[2] *Ibid.*, August 15th, 1857, p. 687.

Textile factories compare most favourably with the buildings occupied in the hardware trades: for though machinery is almost universally used in the latter, it is directed to a great variety of processes in shops of no great size, and often very irregularly disposed. The work is not concentrated upon a limited number of operations of a similar character as in textile mills, but is broken up into a multitude of minor mechanical processes. Hence the like inducement to symmetrical and spacious building is absent, and we meet with labyrinthine work-places, frequently the result of haphazard additions to a building originally small. This condition of things is to be seen in the older manufactories of Birmingham, and the condition of many of the Sheffield factories is not much better, either from an architectural or sanitary point of view.

Respecting the pottery manufacture, the same statements might have been made generally a few years ago, but recently there has been a great and rapid improvement in the construction of the factories, and along with it, the introduction of machinery to effect what was of old simply handicraft. By so much are the health conditions of the potters of the present day bettered.

Chemical works, producing the more bulky and coarse materials for use in the arts, depart furthest, probably, in structural arrangements from textile factories. A principal reason of this is found in the fact that the making of chemical products is, for the most part, attended by the emission of noxious gases and vapours, for the ready escape of which provision need be made. Hence we find such works consist largely of a collection of sheds, with the necessary furnaces and chimneys and enclosed chambers, spread over a considerable space of ground.

To mention one other occupation—that of forging and casting metals—the buildings used are commonly of rough though strong construction, mostly sheds, allowing free currents of air through them.

It is not so much in the shops of large manufacturing establishments that deficient ventilation and confined unhealthy air are encountered, as in those of smaller manufactures and trades, and in buildings used for retail sale. In

many such, the workshops and warehouses are sanitarily unfit, and are answerable for much sickness and mortality.

The neglect of sanitation is particularly marked in places of domestic labour and of sedentary employment, and in the premises of small tradesmen. The recent 'Sweating' Commission Report has made notorious the wretched dens in which the victims of the system are condemned to work; and, if not so bad as these, many shops wherein tailors, dressmakers, and other artisans pursue their calling, are devoid of every hygienic condition, are overcrowded, unventilated, and have the air laden with the products of respiration and with the waste of gas-burners, if not also with worse products from imperfect sewerage. All such places demand action from outside authority to enforce sanitary reform. It is the assigned business of the Inspectors of Factories to visit such workshops, and to suggest improvements, but the undertaking is far beyond the powers of the present staff of inspectors, however arduously they apply themselves to their official duties. In the case of milliners and dressmakers, many of whom are apprentice hands, and at the critical period of woman's early life, the consequences of the insanitary shops are too often evidenced by broken-down health, anæmia, and consumption.

The offensive and unhealthy state of bakehouses has likewise been made patent of late years; and if the dwellings of numerous small tradesmen were examined, ample reasons to bewail the existence of sadly insanitary conditions would be discoverable. In a vast number of cases, the health-conveniencies and comforts of the dwelling are sacrificed to give importance to the shop. Layet justly remarks that the workplace occupies a middle ground in the series of conditions of labour. It is a factor of labour itself, but not one of occupation; and it is necessary always to draw a line between the results of the working-place, and those really attaching to the employment pursued.

Labour in Relation to Sex and Age.—The records of labour in its health relations will be vastly modified, according as work is adapted to, and pursued by, adult men and women, or by young persons and children. Fitness, however,

is not always considered, and great injury to health and bodily development ensues. Rightly to answer the question as to this or that employment being suitable for men, women, or children, it is needful to understand what are the conditions of labour attending it. On the broad grounds of health and morality, so far as the State can take cognisance of the problem, Parliament has arrived at certain conclusions, which are embodied in the provisions of the Factory and Mining Acts. Under the former Act, legislation has gone a step further, and called in the aid of medical men to certify to the ability for labour and the freedom from disease of those presented for work in the early stages of life. For, as a matter of course, the limitation of the hours of work, though a primary and essential condition, does not secure protection of young persons and children from unsuitable labour, nor from employment when of feeble development, or suffering from disease or deformity. Therefore, medical supervision of candidates for labour is an essential provision in any act regulating labour; and examination of existing legislative arrangements, and of their working, will suggest that such supervision ought to be extended and given greater freedom.

Lévy, in his excellent and exhaustive treatise on *Hygiène*, insists upon the necessity for the medical supervision of the young employed in factories, and says (p. 737, vol. ii.), the duly-appointed medical officer must keep them in view from the time they commence work, through the progressive changes in their development, and watch over their physical state under the varying circumstances of their employment. He further regards it as essential that the medical men charged with such duties should not be employed by the masters, but hold an independent position.

Both in France and Germany, the State exercises far greater control over the construction of factories, the processes of manufacture and their sanitary circumstances, than in this country; and in all cases where evidence is forthcoming that disease attends upon a manufacturing process, it calls in the aid of experienced physicians to investigate the circumstance, and to indicate remedial measures. To this proceeding, science is greatly indebted for the knowledge of the causes and results of numerous industrial diseases, and for valuable sug-

gestions for obviating them. References have been made to the more serious evils that attend on children engaged in various occupations. Among others, to their greater susceptibility to poisonous materials, to the depressing influences of sedentary and monotonous labour, and of confinement in workrooms; to their greater proclivity to pulmonary mischief from dust and external causes of illness generally. In like manner, the denial of active exercise in play, the restriction to work devoid of interest to them, must figure among conditions adverse to healthy growth and development alike of mind and body.

In a recent number of the monthly journal, *Hygiène* (May 1891, p. 154), Dr. James S. Torrop, Certifying Surgeon, Heywood, Lancashire, published a brief but instructive paper on 'Factory Children.' He has taken particulars of all the children presented him for examination.

Of the first 2000 cases noted, 1771 'may be described as specimens of the ordinary factory child, and I separate them into three classes —341 superior, 1106 medium, and 324 distinctly below average (Lancashire average, *nota bene*). As to the rest of the 2000, 151 were really fine children, of whom 21 were excellent examples of humanity, weighing 130 lb., 126 lb., and 120 lb. respectively. The balance of the 2000—78 in number—were a feeble folk, amongst whom were some eight veritable pigmies, ten to thirteen years old, and not scaling 50 lb. a-piece. It must be borne in mind that the medium average of Lancashire factory children is not equal to the average elsewhere. The latter standard is hardly reached by the 341 children described as superior; while the medium division is greatly below the standard of good health. This is much more distinctly marked amongst children of thirteen, "full timers," who have passed some years in the factory, than it is in those of ten years of age. Of 60 healthy children averaging thirteen and a half years, and taken as they came (31 girls and 29 boys), the average weight was 74 lb., or 18 lb. below the average of good health elsewhere. The lower division of 324 included many defective and diseased cases, and, of course, the 78 residuum were poor indeed. The cases of defective or diseased children numbered 198.'

He appends to these numerical particulars the observation that 'Factory work is not so excessively laborious; it is the heat, impurity, and dust-laden state of the atmosphere that injures health. The promising child of ten degenerates into the lean and sallow person of

thirteen, and this process is continued until a whole population becomes stunted, and thus the conditions of life in factory towns become a real source of danger to England's future. In addition to the loss of physique, it is instructive to note the deterioration in personal appearance. Out of the 2000 children under notice, only sixteen could be described as handsome, and of these the larger portion were girls from Ireland.'

The preceding quotation is enough by itself to demonstrate the deteriorating effects upon the health and development of children of continuous employment in textile manufactories, to which Dr. Torrop's account especially applies. But other occupations would teach the same lesson when similar conditions of work present themselves; and in the observations to be presently adduced on degeneracy of populations, other reference to this subject will occur.

The air of workshops has both an incidental and an accidental relation to occupation. Its character is largely determined by the nature of the work carried on, and is so far incidental to it. But it is equally of an accidental character, dependent in the first degree on the efficiency of ventilation and on the dimensions of the work-place. Incidental peculiarities are exemplified where heated vapours, or noxious fumes and gases, or dust, either innocuous or poisonous, are given off. These facts are notorious; but the suspension in the air of heavy particles, in spite of gravity, is a circumstance less thought of. It is alluded to in these pages in the account of the operation of file-cutting, and the dispersion of atoms of metallic lead; and it is satisfactory to be able to quote the special researches of Dr. G. Sigerson, of Dublin, communicated to the Royal Irish Academy in 1869-70.[1]

For example, in the air of an iron factory he discovered carbon, ash, iron-balls, and vitreous dust. The iron-balls proved to be globules of magnetic oxide, hollow and readily broken. In a shirt factory there occurred a light brown dust, which consisted of minute fragments of flax and

[1] *Transactions*, vol. i., series ii., p. 13 and p. 22.

cotton. The dust of scutching mills,—which experience has proved to be so destructive of health,—was 'filamentous, from the presence of long, fine branching liber-cells, which help to stuff up the lungs; and it contained a great quantity of broken wood-fibre, whose sharp points and brittle hardness must tease and irritate them.' In printing-office air, analysis showed that dust taken from rafters eleven feet from the floor contained antimony and iron. And without further quotation, it is enough to say that Dr. Sigerson found that, whatever substance was dealt with, particles of it were dispersed through the air of the workshop.

Personal Qualities—Principle of Accommodation.—The results of both the incidental and accidental conditions of work are infinitely diversified by the personal qualities or characters of the labourers, by constitutional peculiarities, by temperament, by education, and by training, viewed apart from the actual health and strength possessed. There ought to be an adaptation between an industry and those pursuing it, in temperament, constitutional fitness, education, and training.

Besides occupations unhealthy to all engaged in them, there are not a few devoid of positive injury, but which become charged with it in the case of people constitutionally inapt, or labouring under some bodily infirmity. On the other hand, examples are numerous of persons possessing a constitutional peculiarity, which saves them from the ills that befall others in the same occupation. Thus, some individuals bear heat and cold with far less inconvenience and injury than others. So, again, some people suffer less from poisoning by lead or mercury, used in their calling, than do others.

Such peculiarities are at times explicable by an appeal to age, sex, and sanitary observances, but when this resource fails, it is usual to attribute them to idiosyncrasy, which is much the same thing as throwing a cloak over our ignorance, or asserting that so it is because it is.

The phenomena in question do not stand alone. Allied to them are the experiences of the effects of prolonged use and habit. Speaking generally, it does not appear that continued exposure to poisons creates insensibility to their

effects; on the contrary, in some people, the longer it lasts the greater grows the susceptibility. The latter seems, as a rule, to hold good respecting lead, mercury, and phosphorus. My inquiries, however, indicate that there is a growing immunity to arsenic among men whose work brings them frequently into contact with it. This inference receives some support from the well-known facts as to Styrian peasants accustoming themselves gradually to taking arsenic, under the sanction of local tradition and opinion, in doses that would prove destructive of life in individuals unseasoned to it.

This influence of use and habit in modifying the noxious effects of numerous articles employed in trades is seen also where tobacco is ground, and a cloud of its dust fills the air of the shop; those habituated to it proceed quite undisturbed with their work, whereas a stranger will find it difficult to get his breath, and suffer excessive irritation of the respiratory passages. The like immunity is observed in the case of combmakers, who work in clouds of dust. The modifying force of habit is likewise evidenced in noxious trades, in which the labourers appear insensible to and unharmed by the foul suffocating odours around; whilst the casual visitor cannot approach the shops without experiencing nausea, vomiting, headache, giddiness, and other disagreeable symptoms. The phenomenon thus partially illustrated is well expressed by the phrase, 'principle of accommodation.'

The State of Nutrition and General Health of workmen is another factor of importance in varying the consequences of labour. The ill-nourished are more susceptible to the disease-producing contingencies of an occupation than the healthy and well-fed. This is witnessed even with regard to poisonous matters used in a trade, as well as to ordinary sanitary incidents. Thus, those who work with lead suffer more if they neglect nutritious food and are intemperate.

This being so, the wages to be earned is a condition of occupation, not without indirect influence upon health; *i.e.* on the assumption that good wages secure good and abundant food. In fact, every-day observation reveals to us the amount of sickness and misery prevailing in employments barely productive of the necessaries for animal existence. And

greater will these evils be when an insanitary trade is in the hands of the young and of women.

But this question of wages and food has an opposite side. There are employments wherein those engaged get excess of food, and especially of strong drink. Excess of food, particularly of animal food, is not uncommon among certain labourers who gain high wages, and also among butchers, and, to a very great extent, among persons well-to-do occupied in indoor sedentary trades. Another incident in connection with the food of the working classes is the very early resumption of labour after meals. Meals are frequently eaten quickly from acquired bad habit, but the practice is as often unavoidable by reason of the shortness of time at disposal, whether by law or custom, and in many cases by distance from home. The provisions of the Factory Act prescribe the time allotted for meals, and rightly discourage taking food in workshops, even where they do not entirely forbid it on account of the presence of poisonous or noxious substances employed.

A wide-spread accidental circumstance of factory occupation is the ignorance of artisans of cooking—whence their samely and indigestible food, and the abuse of tea-drinking, chiefly among the females.

It is a subject for congratulation that so many masters perceive the injury attendant upon the conditions just noticed, and make provision for supplying good, well-cooked food to their workpeople, and suitable accommodation for taking it.

Inseparable from the subject of the state of nutrition, and the food available to working people, is the question of the families they have and the number of mouths to fill. For a large family will, as a rule, operate in the same direction as small wages, but in trades where scope for child-labour abounds, as in the textile trades, and, to a less degree, in the pottery manufacture, a large family implies greater earnings. This fact may be held partially to explain the prevalence of early marriage on the one hand, and the heavy child-mortality on the other. For the gain of increased wages is an inducement for the young mothers to return to work

very speedily after confinement, and to leave their infants to the charge of caretakers.

The Sanitary Habits of Workpeople, collectively and individually, exert a marked influence upon the consequences of their employment. Besides, there are occupations which, as before observed, tend to degrade those engaged in them; there are many others which induce insanitary habits indirectly, as when a trade fails to reward its followers with the necessaries of life. Again, when two occupations are contrasted, a great difference is often observable in the sanitary habits of their workpeople. Thus, as a rule, although unavoidably and constantly begrimed with coal-dust, coal-miners are careful to have a thorough washing with soap and water on returning home from the pits. On the other hand, as far as my observation extends, it is not so with engineers and other workers in metals who get blackened, though in a less degree, with smoke and dust. Their ablutions are far less thorough, and the consequence is a permanent duskiness and sallowness of skin after some years' occupation. It is, however, to be remembered of metal-workers and engineers, that they are exposed not only to black dust, but also to oil and greasy matters, and that this circumstance favours deeper penetration of the dust into the epidermis.

The late Dr. Thomas Williams, of Swansea, drew a contrast in this matter of cleanliness, between the copper-smelters and the colliers of his district, remarking:—'The habits of coppermen (he writes) as regards washing and clothing, differ strikingly from those of the collier.' While the latter has his daily scrubbing with soap and water, the former contents himself with washing his hands and face, as he entertains the notion that the more he washes the more does he sweat at his work.

The indifference of artisans, as a rule, to sanitary precautions and observances, is displayed variously, by careless exposure to changes of temperature and to the inclemencies of weather in passing in and out of their places of labour; by an almost universal aversion to ventilation from dread of draughts; by wearing unsuitable clothes; by wasteful con-

sumption of gas; by indifference to the production of dust, and to means calculated to prevent its ill effects; and by the too common disregard of cleanliness of person and of clothing.

But there is this point to be remembered, which serves in some measure as an apology to the aversion shown to the admission into shops of fresh air; namely, that customary working in warm rooms begets a susceptibility to taking cold from slight changes of temperature.

I am compelled to extend the list of self-inflicted evils. It is, indeed, by only one other item, but that of most weighty importance. I refer to intemperance in alcoholic liquors. When inquiry is made at a factory as to the health of its workpeople, the masters and managers will, as a rule, observe that the particular labour carried on, if obviously requisite precautions be observed, is by no means unhealthy, and that whatever malady prevails among the hands is attributable, not to their work, but to their drinking habits. And unhappily we cannot shut our eyes to the fact that this, if not the whole truth, is too large a portion of it. Though this be true, there exists some connection between employment and the disposition to intemperance. Loathsome work, labour in highly-heated shops and in exhausting operations, furnish apology for the imbibition of alcoholic liquids. And there is yet another cause of intemperance observable in occupations in which employment is subjected to interruptions, either owing to the character of the work itself, or to its temporary abandonment by reason of the season or the weather. The same conditions are provocative of dissipation also.

Hereditary Qualities—Degeneration of Population.—The impression has widely prevailed that manual facility and acuteness of the higher senses may be handed down by hereditary transmission. However this may be, the exercise of an employment undoubtedly develops both special, physical, and moral features. The physique of a professional or literary man re-appears more or less in that of his offspring. And the pursuit of labour of a debilitating character will, in three or four generations, reveal itself by physical degeneration—a sequel aggravated usually by the transmission of constitutional defects, the fruit of vicious habits.

Extensive investigations have been made on this question of the deterioration of race as a result of occupations and modes of life. M. Lévy says, of France, that, in the department of the Haut-Rhin, between 1810 and 1823, the medium height and growth of the inhabitants did not keep up as in other non-manufacturing areas, and the bodily vigour declined. He asserts, also, that women, by reason of their constitutional weakness, suffer more seriously from labour than men, and present a higher rate of mortality. This assertion is open to many exceptions. Its significance is relative only. Given certain forms of employment, entailing strong and prolonged exertion, it will be true generally. But there are numerous light occupations which are not more injurious to women than to men; and not a few in which the latter would be out of place, and apt to suffer the consequences of unfitness. It is, besides, an admitted statistical conclusion, that 'the mortality of males everywhere exceeds the mortality of females at nearly all ages.'[1]

The subject of the deterioration of a manufacturing population in bodily development and vigour, is one far too wide to discuss in this place. The late Dr. Ferguson, of Bolton, took great pains in measuring and weighing the young persons presented to him, as factory certifying surgeon, for examination, during a long series of years, and convinced himself that there was very obvious degenerescence in progress among them.[2] This point is, at the present time, under examination in Manchester by a very competent committee; and a few years since a mine of statistical information was supplied by Mr. Charles Roberts, F.R.C.S., who acted as assistant to the Commissioners appointed to report to the Local Government Board on 'Changes in Hours and Age of Employment of Children and Young Persons in Textile Factories, 1873.'

The perpetual immigration of fresh lives from the country and neighbouring localities is a counteracting force at work in all manufacturing towns, and rescues their populations from the extent of degeneration they would otherwise undergo.

To get some idea of the extent to which the recruiting of

[1] Supplement to the 35th Report of the Registrar-General, 1875, p. 22.
[2] *Sanitary Record*, September 25, 1875, p. 211.

a manufacturing area might be carried, I noted the family origin for two and three generations of 883 individuals engaged in the pottery manufacture in North Staffordshire. Of this number, 772 were born in the 'Potteries,' and 111 in some outside country place. Of 500, the birth-place of whose parents was ascertained, 270 had both parents born in the district; 110 had one parent there born; whilst of the remaining 120, both father and mother were of country origin. These figures show that one-seventh of the artisans (all potters) were imported from the country, that not many short of one-fourth were descendants by both parents of an immediately preceding generation of potters, and almost an equal proportion had one parent who came from the country. These statistics indicate clearly enough how great the fluctuations of a manufacturing population may be, and how large is the influx of new lives into it, calculated to reinvigorate it.

Racial peculiarities conduce to vary the effects of labour on health. Dr. Headlam Greenhow called attention to this fact, pointing out that Welsh labourers suffered in a higher ratio from their occupation than those of the English stock.[1]

The Celtic Irish have unfavourable racial health characteristics; so that an occupation, or a manufactory, largely recruited with workers of this race, may be calculated to have a higher ratio of mortality than its like worked by an Anglo-Saxon people.

The proportion of any one race of inferior physical energies in a community, in a town, or in a manufactory, when sufficiently pronounced, will make its influence felt in the returns of sickness and mortality. Moreover, the same circumstance will disturb the value of labour and affect the means of livelihood, and be manifested in the health statistics of the workers. The following quotation from the excellent inaugural address to the Epidemiological Society of London, by Dr. Walter Dickson, is much to the point. Speaking from his large experience as chief medical officer of the 'Customs,' he says, 'Although several hundreds of men of Irish birth have been under my supervision, and also many

[1] *On the Sanitary State of the People of England—General Board of Health*, 1858, p. 69 and p. 115.

Scotchmen, I have hardly found an instance of gout occurring among them, notwithstanding their mode of life in London does not differ, in regard to the consumption of butcher-meat and malt liquor, from that of the people of this country.' It should be added that gout is very common among the men under his care. Again, it is held that the Jews, as a race, enjoy a greater longevity than other peoples; and, if so, the presence of a large Jewish community should have an effect on the vital statistics apparent in a town or district.

Lastly, we have examples of racial proclivities towards certain trades, which, consequently, lapse in a greater or lesser degree to the race possessing them. The Irish supply the staple for unskilled labour; the Italians display facility for delicate occupations, such as philosophical instrument making, and, as we know to our discomfort, a liking for street music. The Germans emulate the Italians in the latter occupation, and greatly affect the business of the baker and of the hotel waiter.

This phenomenon of racial peculiarities, shown by power of endurance, by greater or less affinity to this or that kind of employment, and by other features, deprives foreign statistics of sickness and mortality of much of their value as illustrative of the consequences of occupation when brought into comparison with what happens in our own country.

The duration of Labour—what it should be in relation to the well-being of the labourer—is a problem which escapes definite solution. The data for solving it, for any group of individuals, are variable and fluctuating. Doubtless the muscular energy may be measured in any one person; but the result will not indicate the capacity and efficiency of the labourers, because that energy cannot be dissevered from nervous force which directs and controls it, and which may either diminish or augment it pretty much at the will of the worker.

In viewing the individual worker, it requires no demonstration to show that his capacity for labour, both as regards time and the amount to be undertaken, will vary according to the physical power he is originally endowed with, to in-

herited qualities of constitution, to perfection of development and function of all organs—not excepting the nervous system and organs of sense. Add to these personal qualities, inherent or acquired aptitude for the work to be executed, whereby one man will accomplish with ease and efficiency what another labours at with pain and performs most clumsily, although the two are alike in physical endowments.

Habit, again, exercises great influence upon the endurance of labour. A man inured to the performance of some simple mechanical operation, or of some task of a noxious character, will carry it on apparently uninfluenced by it, whereas a stranger set to work at the same employment would find it impracticable. A lesser factor is that of race; further, as already noted, certain races seem capable of accomplishing work with facility which others find difficult and fatiguing.

The amount of physical exertion demanded by any sort of work is a primary question. Now, although bodily labour, or muscular toil, may undoubtedly be carried to excess and injure health, it is a circumstance of no such great weight as many suppose. The human frame has immense recuperative power in a sound man sufficiently nourished; and will permit the daily performance of hard labour for a long period without damage. Up to a certain point muscular activity augments along with muscular power and endurance; and when physical energy does break down, it is less from failure of that power than by flagging of the nervous forces.

If the statistics of some active occupations show a high rate of mortality, the fact is not wholly attributable to the amount and duration of the physical labour demanded, but more or less to the greater frequency of accidents in such employments, to the circumstance that not a few enter upon them who are unfit to follow them by reason of constitutional debility, or to the acquired habit of drinking alcoholic beverages where an occupation is heavy and exhausting.

It therefore comes to this, that every individual having fairly sound judgment, is the best judge for himself of what he can do and what he can endure, provided he relies upon sufficient experience; and the proper limit of a man's labour is a purely relative matter; relative to his inbred powers, and to his capacity and willingness to employ them, and

subject only to the description of work to be undertaken by him. The last-named factor is of the highest importance, and has to be arrived at from an examination of all the conditions of labour recognised.

Statistics do not establish the opinion that strong labour is, *per se*, prejudicial to life. For example, quoting the statistics of Dr. W. Ogle, where 1000 is taken as a standard of comparison in estimating the mortality ratio of different trades, it is seen that whilst that of blacksmiths is only 973, that of iron and steelworkers, grouped together, only 869, and that of coal-miners only 891; the death-rate of hair-dressers is 1327, of tailors 1051, of printers 1071, and of bookbinders 1167. In short, the teaching of statistics is, that trades requiring strong, and those demanding moderate exertion, are far away more healthy than others demanding little or no bodily effort. And all this is in harmony with what physiology proves, that the exercise of organs, and especially of the muscular system, is a pre-requisite to health and preservative of life.

The practical conclusions are, that if the law is to interpose and to be called upon to limit the duration of labour, the persons to be in the first place selected to receive the benefit, should be those engaged in pursuits which are demonstrably most inimical to health and life; and that its intervention could not logically be claimed in behalf of those engaged in pursuits calling for stronger bodily labour, but rather in the interests of sedentary workers. This argument, based upon comparative mortality returns, must not, however, be pressed arbitrarily; since beside physical effort, there are several other factors of importance that must be taken into account. These are to be found in the surroundings and circumstances of an employment. For instance, that carried on in the open air, unless it has some special unhealthy qualities, has health conditions which present no claim to special consideration, provided that the work stop short of disabling fatigue. But when labour is performed in factories and shops with overheated and impure air, where workmen are subjected to excessive heat, to steam and noxious vapours and gases, to abounding dust, to industrial details involving strain upon the attention and mental wear, then what may be called an

artificial limit to the duration of labour is called for, inasmuch as muscular fatigue has conjoined with it incidents which add an intensity to it as a health factor. We have arrived thus far in this brief study of what should be the duration of labour, and have found that no general physiological law on the matter can be established; that physical exertion, *per se*, has no ill result to health and life, unless pressed to an extreme, and that the labourer himself is the best judge of the limit; that outdoor work, unaccompanied by special insanitary conditions, may be left to determine its duration without risk; but that there are many trades and manufactures presenting features of a decidedly unhealthy character which justify the enactment of regulations as to the duration of labour in them.

At the same time, it must be perceived how complex and difficult a problem it would be for the legislature to discover the manifold circumstances of the almost endless kinds of occupation, and to apportion the correct amount of exertion and time to be allowed for each; supposing the Utopian ideas of some reformers could induce the State to act the part of a common parent to the industrial community, and assume to itself the duty of preserving all occupied people from the various ills threatened by their employment, and thereby relieve them from the duty of self-preservation, of choosing their own place and time of work, and of using their own common senses in avoiding evils they can themselves perceive and guard against.

The success of trade-unionism seems to render it very needless to invoke the action of Parliament to regulate the conditions and duration of labour, seeing that the persons employed possess the control over them, and can, for the most part, dictate to masters their own terms as to time, and most of the circumstances of employment; and that in but few occupations have they failed to reduce the hours of work to eight and even less, leaving sixteen to play and sleep. In the few instances where factory work exceeds eight hours' duration, it so happens because there is piecework, and the workmen choose to prolong their labour even when to do so possibly is unadvisable.

CHAPTER III

CONSIDERATIONS REGARDING THE CONDITIONS AND CIRCUMSTANCES OF LABOUR IN THEIR BEARINGS UPON STATISTICS

It is evident that the conditions of labour enumerated in the previous chapter must all and several affect the vital statistics of occupations, and that their influence will vary according to the number of them attached to an occupation, and to the energy of their action for good or ill. Now, both their number and their activity will differ not only in different employments, but also in the self-same employment, for in no two industries will the circumstances of labour be precisely the same, nor the same at all times and places.

These circumstances, as already seen, are either incidental to the occupation, or simply accidental; consequently, to arrive at the knowledge of the effects of an employment upon health, we must first of all determine which of its conditions are incidental and which accidental—a task of no small magnitude, and often not within our power to accomplish satisfactorily. In some employments, as in that of the manufacture of lead, we are in no doubt as to the active cause of illness among those engaged in it, nevertheless we are unable to assert that the sickness and mortality found in it are wholly due to the poisonous material dealt with; for we are cognisant of the co-operation of a variety of accidental circumstances. Examples of such are—the construction and ventilation of the manufacturing premises, the special arrangements providedfor the business; the relative proportion of the two sexes, and of the ages among those employed, their cleanliness and general habits.

If, therefore, in a trade with such obvious and potent

incidental health factors, we cannot say with certainty what proportion of its sickness and mortality is attributable to it, our difficulties are enormously increased when we attempt to solve the like question for occupations in which the incidental conditions are greatly surpassed by the accidental; and these latter are certainly the more numerous.

Moreover, to solve the problem in question, we have no better aids than those afforded by comparative returns of sickness and mortality. The upshot is, that the vital statistics of occupations can only be general and approximative. Mortality returns of themselves are insufficient to show to what extent the deaths in an occupation are due to its pursuit. They represent the number following that occupation who have died, and so afford a crude idea of the relative frequency therein of certain fatal forms of disease. Again, if the entire number of individuals be known who work in the trade—information seldom available—it is possible to calculate the percentage which has succumbed to the several diseases recorded. But, withal, the insight thus gained respecting the intimate relations between the employment and the diseases connected with it, is little enlarged.

They take no cognisance of the age and sex distribution of the employed, and are silent as to accidental conditions that have affected the death-rate. The most that can be said for them is, that they cast some light upon the relative salubrity of different trades, viewed in the entirety of their working conditions and surroundings, when a comparison is attempted.

Moreover, mortality returns furnish no true measure of the health conditions of different occupations brought together for comparison sake. For one trade may produce a large amount of sickness or feeble health, and spare life many years; whereas another will be attended by severer illness and shorter life, that is, will exhibit a higher rate of mortality.

Another requirement, when appealing to local mortality records—which is frequently wanting—is, a knowledge of the proportion of those occupied in a calling relatively to the entire population of the locality in which the trade is exercised. Similar information is needed when the problem is to discover, in the case of any manufacture, the vital statistics

of those following one department of it as compared with another, or with the entire body of workers.

In the previous chapter some important remarks by Dr. W. Ogle have been introduced to illustrate the disturbing influence on mortality tables, of circumstances of occupation involving variety in the demand made on the bodily strength and vigour. For, as he points out, those employments that require the greatest strength, are such as naturally exclude the weaker members of a community, and consequently comprise a larger proportion of strong lives, whereby 'their death-rates will be unfairly lowered as compared with death-rates in occupations of an easier character, and still more as compared with the death-rates among those persons who are returned as having no occupation at all. . . . The several industries do not start on equal terms as regards the vitality of those who follow them' (*op. cit.* p. 23).

Again, to quote from Dr. Newsholme's excellent work on *The Elements of Vital Statistics*:—

'The proportion between the number engaged in, and the number dying in, any given occupation, expressed as a rate per 1000, is also fallacious. As already seen, the death-rate in the general population varies greatly at different groups of ages. The death-rate among those engaged in any one trade or profession would similarly vary according to the relative number at the different ages engaged in it. In other words, it would depend on the *ages of the living*, which would vary in every occupation, (*a*) according as persons enter it early or late in life, and (*b*) according as the numbers that annually enter it increase or decrease. Dr. Farr, in his Fourteenth Report, gives the following example of the mistakes which would follow the adoption of this method:—The death-rates of all farmers over twenty years of age is 28 per 1000, of all tailors 20 in 1000; but when tested by a comparison of the death-rate among men of corresponding ages, farmers are much healthier than tailors' (p. 151).

Once more, the mean age at death has been much relied upon as exhibiting the relative healthiness of different trades. On this topic we cannot do better than quote Dr. Newsholme's observations:—'In the comparison of different classes of society, and those engaged in different occupations, serious errors have arisen by the incautious use of this test to determine their relative sanitary condition. It would be absurd, for instance, to draw any inference from a comparison of

the mean ages at death of bishops and curates, as men do not usually become bishops till they have passed the middle period of life. Similarly, in comparing the gentry with tradesmen. Most of the gentry are retired tradesmen, and their mean age at death is, therefore, higher than that of tradesmen. The low mean age at death of dressmakers has been adduced as a proof of the unhealthy character of their employment. Without denying the latter fact, the low mean age at death of dressmakers is no more a proof of their insanitary circumstances than is a low mean age at death among the pupils in a boarding-school. The use of the mean age at death as a test of the sanitary condition of different classes, is only justifiable when the age and sex constitution of those living in the classes compared is the same. If only a section of a class is taken, then this section must be uniform in age and sex constitution with the section of another class, with which comparison is instituted' (*op. cit.* p. 247).

The experience of Friendly Societies furnishes valuable information as to the prevailing diseases which incapacitate its members from following their trade, or which become the actual cause of death. But this information fails to show how far the sickness is attributable to the employment followed, and it leaves out of sight the influence of its labour requirements on the age of its followers, and on the bodily strength demanded. As regards the last-named matter, it is one of great weight in determining the ratio of sickness; for, necessarily, a trade calling for strength has to be surrendered on account of a lesser amount of sickness than one involving little exertion, and at an earlier period after its onset.

A minor consideration respecting the acceptance of Friendly Societies' returns in estimating the sickness and mortality of a trade is, that they do not reflect the exact state of things as regards the whole number of persons engaged in that trade. To a certain extent the members are a select body, representing the more steady and prudent of the number, and containing a certain proportion of individuals who are not in actual work as artisans, and escape, more or less, the disadvantages to health connected with the employment. The consequence is that the returns convey a more roseate view of its vital statistics than positively belongs to the occupation.

Statistics recorded in books on industrial diseases, both English and foreign, must be used with great circumspection. Ofttimes they are based on too limited numbers, or on data indiscriminately collected, or they apply to bygone times, when the surroundings of occupation differed widely from those of the present time; and with respect to foreign statistics very great allowance must be made, as heretofore remarked, for the different racial, social, and manufacturing conditions prevailing abroad compared with those of our own country. For example, how unlike are the conditions of employment and of living of the silk-weavers of Lyons to those of the same trade in England, may be learned from the recent treatise (1890) of Dr. Pièrre Givre, on *Tuberculosis among the Silk-workers* in that city. Instead of their dwellings being outside the mills, in the adjacent neighbourhood, the custom in Lyons has been, and still is to a large extent, for the employés to lodge within the self-same rooms in which they work: the sleeping, cooking, and eating going on in confined spaces imperfectly partitioned off from the general working area. They are thus constantly breathing the vitiated air of their living-apartments, mingled with that of the work-room, permeated with more or less dust and animal exhalations.

Statistics collected years since, become more and more inconclusive as time elapses, by reason of the perpetual and rapid changes in the modes and processes of manufacture. So quickly do these operate that, within a decenniad, not a few kinds of work are more or less completely displaced. To sufficiently establish the purpose of this chapter, it will be well, at the risk of some repetitions, to show how, and in what measure, conditions of labour affect industrial vital statistics.

Occupations bearing a common designation.—It is usual, in collecting statistics, to deal with occupations under their commonly-received appellations. Thus we have a recognised division of manufactures into textile and non-textile, and statistics are collected to represent and contrast the comparative health-phenomena of those two divisions. When greater particularity is aimed at, comparative statistics for

the several forms of textile occupations are produced. For instance, the health-aspects of the cotton are compared with those of the woollen, of the silk, or of the linen trade. It is true that these several manufactures have a common feature in being textile; still they differ among themselves in the material and processes used, and consequently no reliable general deduction can be made respecting their healthiness applicable to them as a whole.

In like manner, any one textile manufacture may be examined apart, and the discovery of its sanitary bearings be attempted, by collecting returns from a number of mills. Even then nothing more than a general conclusion respecting the mortality and sickness pervading the business, as a whole, is attainable. We arrive at no satisfactory decision as to what are the producing causes—how far they belong to the trade or are but accidental conditions. For when two factories making like materials are contrasted, in all probability the ratio of sickness and mortality in the one will be found to vary greatly from that in the other; intimating the operation of morbid factors not existent in the essential features of the manufacture. In fact, the consideration of the conditions of labour, as set forth in the preceding chapter, will make it abundantly evident where the causes of diversity in health aspects are to be looked for even in the self-same employment. To cite for illustration the cotton manufacture.—Any two mills will differ more or less in sanitary arrangements, in the quality of the material made, in details of machinery and in processes adopted, in the relative number of males and females and of adults and children employed; in internal management and discipline, as well as in matters outside, such as the quality of the house accommodation available in the locality for the hands employed. And to these varying particulars, all affecting vital statistics, must be added others, such as the urban or the rural position of the mills contrasted, the antiquity or otherwise of the town in which they are respectively located, and particularly the circumstance if the town have or have not been the seat of a manufacturing industry for a long period—a matter seriously affecting the vitality of its inhabitants.

To emphasise the divergencies to be found between mills,

even those occupied in producing like articles,—in the broad commercial sense,—it is well to note some differential minutiæ that may be discovered. For instance, one mill weaves an inferior or coarser cloth; the consequence is, that the earlier operations are more dusty, and weaving itself attended by a more steamy atmosphere, charged also with extra dust from the clay dressing employed. Such an establishment will differ more or less in these details, and consequently in its sanitary results, from a cotton factory using the best cotton and weaving a high-class cloth, devoid of the clay-dressing.

Again, the market available at a particular time, and the character of the article in demand, cause variations in manufacturing and other details, even in the case of the self-same factory. Thus, in worsted mills, yarn may be at one time in greater demand than at another; and, as a sequel, whilst the number of weavers employed will be reduced, that of spinners is augmented; and, inasmuch as the work pursued by the two sets of operatives differs, so likewise do the health-conditions. And although alike called worsted mills, two such establishments in the same town will materially differ, not merely in the relative proportion of hands engaged in spinning and in weaving, but likewise in that of the two sexes and of adults and children employed,—these particulars being determined by the nature of the material made, by the processes employed, and by the amount of bodily vigour required. The incident last named is ever in operation as a cause of fluctuation among the employed, as witnessed by the frequent changes of employment from one department to another, by reason, for the most part, of inability to continue to perform work; whether from advancing years, from sickness, or from some accidental infirmity.

Nor must we lose sight of the fact, that occupations characterised by what is positively obnoxious to health, as where poisonous matters are used, will undergo greater fluctuations among their employés, and in consequence present greater difficulties to the collector of statistics.

Again, the proportion of young to old, and that of males to females, is subject to fluctuation in factories of all kinds, according to changes taking place in the method of working. Thus, improved machinery will enable a certain industrial

occupation to be performed by women or by children, that has heretofore been done by men and adults only.

The mere fact of prosperity of a trade, and the commercial position of a factory, will not be without effect upon the age and sex of the employed. A prosperous manufacture offers an inducement to workmen to remain, and hence its operatives will have a higher mean age than a factory less successful. So, likewise, one factory will differ from another of the like trade, when its products are less costly, and cheapness is the principal end in view, by resorting to the cheaper labour of women and children. It is enough to mention these variations between places of manufacture, in order to show how the statistics of age and sex, and, co-ordinately, those of sickness and death, may be affected when occupations of like denomination are contrasted, and even when a given factory at one time is contrasted with the same at another.

Another agency is at work in like direction,—namely, the rules and regulations, enforced alike upon masters and workpeople, which the ingenuity of trade-unions devise, for the purpose of advancing wages, curtailing production, and limiting competition in labour. Sometimes these rules are directed against the employment of women; at others, against that of children. In olden time, the privilege of taking on apprentices rested with the master or the master hands; but now, in many trades, it is denied them, and controlled by trade rules, forbidding instruction in a calling, except to a limited number, at the dictation of the workmen. The glass-making trade furnished a well-marked example of this state of things pushed to excess. The result was a vast curtailment of the trade in this country.

Alterations of the character implied, affecting, as a necessary consequence, the age and sex distribution of workers in factories, bring about corresponding changes in vital statistics, and tend to vitiate calculations and conclusions made regardless of them.

Most of the illustrations of the present theme have been borrowed from textile factories; but, in varying degrees, all sorts of occupations would contribute a like series.

One other illustration, though scarcely needed, of the

errors that must creep into statistics gathered in past years respecting any trade, viewed at large, is furnished by the business of the miller. The workers in flour mills notoriously suffered severely by their calling; but modern invention has revolutionised the process of flour-grinding in all large establishments, to the great advantage of the employed. Consequently, returns of the diseases and sickness of millers, made even a few years since, have ceased to be applicable; and a comparison instituted with regard to the health aspects of mills of the old style with those of the present day would be fallacious.

Enough has been said to show that, in the case of factories, when we seek to calculate the relative mortality of one as compared with another, we are not dealing with a simple question, but rather with a congeries of unlike health factors, and can therefore advance no absolute fact respecting their comparative healthiness.

The same difficulties beset comparative investigations made concerning all occupations; and especially do they abound in mining operations, in which the variations in health conditions in different pits, worked for the same minerals, surpass in degree and kind those witnessed in factories.

Mixed Pursuits in Factories.—There is yet another circumstance of the same order to be mentioned, namely, that besides the hands engaged in producing the special article or material which lends its name to the factory, there are others who are occupied in employments only indirectly connected with it, and of very varied scope. For example, in a textile or a needle manufactory there are people occupied in packing, in printing, and in affixing labels to packages, in engineering work, in making boxes and barrels, besides a variable number of unskilled labourers. And over and above all such mixed operations, the ordinary departments themselves of many manufactures are so different in kind and in sanitary aspects, that they might well be regarded as distinct trades. For example, the decorative department of the pottery manufacture differs, *toto cœlo*, from that concerned

in the making of the ware, as does also the making-up department in an india-rubber factory from all preceding branches. Moreover, it is worth while to remember that the current tendency of manfacture, trade, and commerce is to collect within the same building, and under the same general management, all those various operations necessary to turn out the articles produced in a finished form, ready for retail sale, packed, decorated, and labelled. Accordingly, a modern manufactory is no longer the producing sphere of a simple article, but the centre for miscellaneous trades, having as many varied health features.

The conclusion follows, that statistics of sickness and mortality collected for occupations, wherein a great diversity of processes prevail, although popularly known under a common designation, do not express the position of those occupations in their influence upon health. They, in truth, possess little more value for that purpose than would a collection of statistics for a group of acknowledged dissimilar trades.

The corollary is, that rightly to apprehend the pathological influences of a complex calling, there must be a correct valuation discovered for each and every department that presents sanitary features peculiar to itself.

Comparative Statistics of Different Towns.—In the previous chapter on 'the Conditions of Labour,' the propriety of noting the circumstances of any two or more towns compared, with regard to the climatic position they severally occupy, and their sanitary site and surroundings, has been insisted on as causes influencing their vital statistics. Other modifying influences are to be found in the relative antiquity of the towns contrasted, the period during which factory labour has existed in them; the density and movements of their populations, the accommodation available to the working classes, the racial origin and general *morale* of their inhabitants, the predominating occupations, and the relative distribution of age and sex.

It is readily conceivable that an old manufacturing town will contain a greater proportion of lives of a weak and degenerated type than a newly-established industrial centre

with a population recently introduced from surrounding districts, and containing a larger proportion of vigorous and youthful lives. The same thing would happen in the case of a town in which an old industry had revived and an increased manufacturing activity been set up.

Failure to recognise facts of this kind has often been witnessed where comparisons have been instituted between different towns for the purpose of bringing into light the effects of industrial pursuits upon a population. The conclusions arrived at by such proceedings are laden with fallacies. For illustration—Of what use can a comparison of mortality and sickness returns be between two such places as Liverpool and Preston, for the purpose of estimating the effects of the special manufacture of the latter town upon the health of its inhabitants? The wide divergence in their health conditions reveals strong contrasts, but forbids inferences as to the influence of the factor sought after.

Town-made and Trade-made Diseases.—No doubt can be entertained that trade-made diseases prevail extensively, and make a decided impress upon mortality statistics. At the same time, it must be granted that those statistics reflect in a higher degree the general sanitary state of localities; a fact, as it appears to me, often unduly ignored by writers on trade diseases, who have magnified their subject and attributed more than is due to trade processes and incidents belonging thereto. The following wise and cogent remarks by Dr. W. Ogle demand attention from writers both on general sanitation and on industrial disorders. They are *à propos* of the prevailing practice of contrasting the vital statistics of towns in order to exhibit the advantages of sanitary arrangements. He thus expresses himself (*op. cit.*, p. 18.):—

'That sanitary administration can do much to lower the mortality of a given place is indisputable. . . . But to attribute the whole, or even the greater part of the difference of death-rates between one district and another to this cause, is to ignore factors of the very greatest importance, which exert influences over which sanitary authorities have practically little or no control. The evils and the diminished vitality that are caused by poverty, crime, personal un-

cleanness, drink, and excess of all kinds, as also by the close aggregation of human beings in places that offer the best chance of lucrative employment, and especially by the unhealthiness of certain occupations, are such as can at best be mitigated by the sanitary authorities, and often lie entirely outside their power of interference. Yet there is good reason to believe that these are the causes to which the main part of the difference between one part of the country and another, in the matter of mortality, is due.'

It is interesting to observe how closely this opinion tallies with that expressed by Mr. Neison, quoted in the preceding chapter (p. 21).

In what proportion town-life and trade processes severally influence the health of artisans will ever be debatable. Nevertheless the concurrence, if not the predominance, of general sanitation in influencing favourably the health of a manufacturing population, is well illustrated by the history of the silk town of Leek, in Staffordshire. It was one of the towns whose mortality statistics were specially inquired into by Dr. Headlam Greenhow in 1857 (see *Papers relating to the Sanitary State of the People of England*, 1858). At that date it figured as having the highest mortality from pulmonary phthisis of all towns in England and Wales examined. Of the deaths from all causes during the period 1848-54, as many as 445 per 100,000 persons were assigned to phthisis, whilst 646 were entered as due to pulmonary affections; whereas, at the present day, the death-rate from consumption only slightly exceeds that found for the country at large. Moreover, the greatly respected and energetic Nuisance Inspector of the town, Mr. Farrow, is able to show an immense reduction of the annual mortality rate from all diseases. During the last twenty-five years that rate has decreased by 10 in 1000 of the living, representing an increased average length of life of each inhabitant of eight years. From an abstract most kindly given me, it appears that whilst the mean age at death has remained stationary in the case of the gentry and the professional classes, it has advanced 5·6 years for tradesmen and shopkeepers, 4·5 for artisans and labourers, and as much as 7·4 for workers in silk factories. To what causes is this pleasing transformation in the hygienic condition of Leek to be attributed?

The staple trade of the town remains the same, and has prospered above that of silk towns at large. The processes of manufacture are not materially changed, although improvements of machinery have facilitated production, lessened labour, and done away with a few operations unfavourable to health. In other words, the incidental circumstances have been to some extent amended hygienically. Nevertheless, on the whole, the amelioration of accidental conditions has been more marked. Ill-built and ill-ventilated factories have given place to very superior structures, in which attention has been bestowed upon sanitary details; but, above all, the town as a place of residence has been very largely improved in all hygienic particulars. The habitations of the working classes have undergone great change for the better; numerous unhealthy courts done away with or rebuilt; the old wells, scattered at random, have been closed, and an excellent water-supply obtained from the neighbouring hills, and sanitary inspection has been a reality, and not a pretence. There yet remains another, and probably the most potent, factor in diminishing the death-rate of consumption,—viz., the extension of the Factory Act, forbidding the employment of young children until they have attained the age of ten years, and limiting that of females at all ages, and exercising salutary control over the chief sanitary features of the factories. On weighing both sides of the question, the balance here inclines to the side of improvement of the general hygiene of the town and its factories, rather than to amendments in the details of manufacture. The effects of the last-named factor are, however, not to be ignored, though the inference holds good that more distinct benefits to the health of a community are to be realised by improvements of the accidental than of the incidental conditions of employment.

Further, the town history just narrated illustrates the proposition elsewhere advanced, that the mortality returns alone of a locality furnish no reliable data for calculating the effects upon life and health of a manufacture exercised in it. Another general deduction is, that when an occupation has no very decided health features in connection with its processes or with the materials used, the consequences of

its incidental are outweighed by its accidental conditions. Lastly, as Dr. Ogle observes, the statistics of mortality for trades giving employment to small numbers must be used very cautiously.

Accidents.—An important circumstance to be kept in mind when analysing the mortality returns of an employment, is the proportion of deaths caused by accident. In the bulk of employments, indeed, this factor counts for little; but in the textile factories, and in the occupation of mining, especially the latter, the ratio of deaths is very materially affected by it. The result is, a lower apparent mortality from the usual category of diseases. Further, as young persons suffer in a higher ratio, the average duration of life is adversely affected.

Another incident attaching to the vital statistics of dangerous occupations is, that many non-fatal accidents terminate in disablement. Such injured individuals are drafted to other businesses, and, as instances of damaged lives, swell the sickness and mortality of those employments unfairly, and detract from the mean value of life. Again, we must take into account that, as the work of a collier requires considerable bodily vigour, it will be taken up by the stronger members of a community, and consequently should occupy a superior position in vital statistics to occupations suitable to weaker individuals. This circumstance again gives a fictitious value to miners' lives, and its results are augmented by the necessary secession of those from the employment whose health grows unequal to the task, whether from debility or consumption, and who thereupon get numbered with the general population and increase its ratio of sickness and deaths.

Official Returns of Mortality.—The deficiencies in the official returns of the mortality of different trades for supplying data for correctly estimating the effects of employment upon health are universally recognised. The decennial census of the population does not furnish reliable returns of the number of individuals engaged in the several occupations enumerated; and, without this information, it is not

possible to calculate precisely the ratio of mortality. Again, the designation of occupations is loose and inexact; and, with respect to the returns made of age, they are laden with misstatements, especially when women are in question. Further, in the record of persons pursuing a trade, the distinction between masters and men is not drawn, although the sanitary position they severally occupy is one of great diversity. Likewise, in the instance of combined trades, no clue is given as to which the individuals registered have specially followed, notwithstanding that the two occupy decidedly different sanitary positions.

Further, to establish the above remarks, the following extract from Dr. Ogle's oft-quoted report is highly valuable:—'The number of persons in many of the individual trades, and still more the numbers at each age-period in such trades, are small. The amount of confidence in the results is, of course, *cæteris paribus*, proportionate to the number of observations, which depends on the number of persons engaged in the occupation. The figures, therefore, which relate to small trades, or to age-periods where the numbers are few, should be received with due hesitation.'

If we turn to the *Registration of the causes of death*, many defects manifest themselves calculated to seriously vitiate any inferences as to diseases attributable to occupation. Of a considerable percentage of deaths the cause is not registered; and an equal proportion are assigned to causes ambiguous and even ridiculous. And when the cause registered appears rational and adequate, it expresses nothing more, in very many examples, than the final symptoms ushering death in, expressed in descriptive or figurative language. The returns are also greatly influenced by the prevailing pathology and phraseology of the day. In former years, sudden death was constantly attributed to apoplexy; it is now as commonly put down to heart-disease; and inflammation of one or other viscus was in the past called upon to account for a host of dead; whereas, at the present time, its victims appear comparatively few. To add one more illustration. Phthisis and consumption are terms very loosely used, and can be relied upon as denoting little else than

death following a wasting disease, with or without cough. Other examples to the like effect might readily be adduced.

The perusal of the conditions of labour treated of in the preceding chapter, will render it needless further to exemplify their influence, and the direction they take in modifying numerical conclusions. As a collection of counters admits of a multitude of permutations and combinations at will, so do bare figures allow various interpretations according to the bias and the point of view from which they are regarded, and when the circumstances they symbolise are not fairly and fully grasped.

CHAPTER IV

CLASSIFICATION OF OCCUPATIONS

OCCUPATIONS are so multitudinous, and differ from each other so widely in character, that, for the purpose of study, some classification of them is necessary, and the course that suggests itself as the best is to group them according to their health-characteristics and sanitary surroundings. But this basis of classification is not readily applicable to all in the first instance; and I propose to make two primary classes or groups, founded upon a principle of political economy, viz.:—(1) According as they directly contribute to the wealth of the country by raising new material from the earth, or by so operating upon existing materials by manufacturing processes as to enhance their value; and (2), or as they are non-productive of new wealth. The latter occupations are exemplified by those of the public, who, though profitably engaged, are in the position of consumers, or only of media for exchange and barter. The former may be described generally as the manufacturing, the latter as the non-manufacturing group.

These two divisions possess the merit of convenience, but not of accuracy. In fact, no absolute demarcation of employments can be made. The really non-manufacturing employments merge by numerous kinds of labour into the manufacturing series. And not only so, but there is a perpetual change going forward among the industries of the country whereby the handicraft of one year is transformed into a manufacturing process in the course of another. Indeed, the tendency of the time is to supplant the individual hand-worker, instructed in all the details of his employment, by the factory operative who has to depend upon the work-

ing of a machine, and is incapable of carrying out the manufacture he is engaged in from beginning to end. For example, the simple handicrafts of shoemaking and tailoring have of recent years been raised to the position of manufactures by the invention of machinery and the establishment of factories.

Further, the mere augmentation in value of an article by labour expended upon it, fails as a basis for settling the question whether or not its production is, or is not, to be reckoned a manufacture. For instance, an artist who paints a picture, or produces a piece of sculpture, converts natural and common material into an artistic product of vastly increased value, and is so far a creator of wealth, but he would indignantly resent being called a manufacturer.

Another impediment to a strict allocation of industries to one or other division arises from the fact, that, in well-nigh every manufacture there are operations which, in themselves, do not rise above the character of simple mechanical acts; nevertheless, they cannot be detached from the manufacture itself as separate crafts, but need to be considered with it in any examination of its sanitary features. Moreover, many of them have more important bearings upon the health of the employed than the larger mechanical processes with which they are conjoined.

To resume the examination of the scheme of classification I propose to adopt. The class of non-manufacturing occupations resolves itself into two primary divisions or sub-classes, according as they are of a non-trading or of a trading character. And forasmuch as no distinct dividing-line can be drawn between many trading employments and manufacturing operations, I have created a third sub-class, entitled mechanical trades, for such of them as approach nearest in details to manufactures, and constitute a sort of mid-link between the two.

The first sub-class of non-manufacturing occupations comprises fourteen orders, each presenting hygienic features peculiar to itself. They are—

Order 1. Persons of rank and property having no definite employment.

2. The Governing classes.

3. The Professional classes.
4. The Army and Navy.
5. Officials of public departments.
6. Clerks, legal and commercial.
7. Commercial Agents and Travellers.
8. School Teachers.
9. Fishermen, Bargemen, and others employed on the water.
10. Laundresses.
11. Domestic and other Servants.
12. Individuals concerned in the transport of persons and goods.
13. Labourers.
14. Costermongers, Street-hawkers, and other miscellaneous dealers.

The second class includes persons engaged in wholesale and retail trades not recognised as manufacturing. It admits of eight sub-divisions or orders—

1. Retailers of food and drinks.
2. Tobacconists.
3. Chemists and Druggists.
4. Dealers in articles of clothing.
5. Stationers and Booksellers.
6. Dealers in metallic goods.
7. Miscellaneous retail trades.
8. Hairdressers and wigmakers.

Following next in order is the sub-class I have called *Mechanical Trades*. These, for the convenience of description, are sub-divisible into two principal sections, according as the materials employed belong to (A) the mineral or to (B) the organic kingdom of nature; the latter again resolving themselves into two sub-sections, according as they are (1) animal or (2) vegetable. This collection is admittedly miscellaneous, but it affords means to bring together employments having no general resemblance in sanitary factors, excepting in the prevailing requirement of power as wielded by human strength alone or in co-operation with mechanical appliances, often of the simplest kind. Associated employment, moreover, prevails in these mechanical trades in greater proportion than in the previous sub-class of retail trades.

The second of the *primary* divisions of occupation constituted follows next. Its characteristic is, that it adds wealth to the community by raising new material from the earth, or by so dealing with existing material by processes of manufacture as to enhance its value. It is represented by agriculture, mining, and manufacture.

The position of the first of the three employments named is beyond debate. Mining claims the like position, for it undoubtedly adds new wealth to the nation, and has no pretension to a position among manufacturing processes. However, as its leading hygienic feature is the production of dust, with consequent injury to the human economy; and as this same phenomenon attaches to the most important occupations of a truly manufacturing character, it seems to me better to range mining immediately before those manufacturing operations which fall under the heading of Industries causative of dust, and injurious thereby to health. This proceeding further appears the more desirable, as it will afford opportunity to prefix a general outline of the pathology of dust-produced diseases, elucidating the consequences of the miner's employment, and their relation to the effects of dusty work in general.

By this arrangement agriculture, with its subordinate branches, stands alone, occupying a position between mechanical trades and mining.

The hygienic and pathological relations of mining and manufacture demand for their adequate examination to be classified upon some distinct principle. The one I have chosen is etiological; wherein the attempt is made to find a position for each occupation in accordance with the most definite disease-producing factor discoverable in it, and really incidental to it.

To carry out the principle of classification just referred to, I have instituted eight groups of etiological factors.

Occupations injurious to health by—

1. The generation of dust.

2. The employment of materials of a distinctly poisonous or highly noxious nature.

3. The evolution of vapours of poisonous or injurious properties.

4. The action of excessive temperatures.
5. The action of electricity.
6. Abnormal atmospheric pressure.
7. Excessive use, friction or strain of the body or of special organs or parts.
8. Exposure to infectious, contagious, and parasitic diseases.

A supplementary group might be instituted for occupations wherein mechanical injuries and accidents are a prevailing characteristic, but it seems needless to do so, because the strictly health features of those employments are of primary and incidental importance, whereas injuries following upon their pursuit are, as the word implies, accidents or events to be conceived as avoidable. For example, accidents are sadly frequent in mining, but the primary pathological conditions of that occupation are the production of dust, whilst the presence of foul air, and accidents, are casual phenomena. Hence, accidents will best be treated of in connection with each occupation in which they occur.

The classification adopted is the same in all essential points with that I introduced in my address on 'Occupations and Disease,' when I had the honour of presiding at the Public Health Section, during the meeting of the British Medical Association when held in Bath in 1878. It is one not boasting of completeness, but it enables me to bring together those occupations which have common health characteristics, and to discourse of the evils attending their pursuit. And, as said before, there are many employments not reducible to any system, and partaking of varied and dissimilar sanitary conditions.

The further sub-divisions of the primary groups will appear in the special chapters devoted to their examination.

The range and severity of the several groups enumerated differ widely. The first three of them operate extensively, and in a multitude of occupations; the rest have limited spheres of action, and, for the greater part, possess less energy for evil.

Again, it is seldom that the morbid conditions represented by any one group are found alone as disease factors. Those of two or more may be conjoined; when the problem arises—

to which of them do the observed injurious consequences belong? For example, the evils of dust are frequently aggravated by the inherent deleterious qualities of that dust; and may be further intensified by the presence of heat and moisture. So, again, the overheating of workrooms may have its injurious consequences augmented by vicissitudes of temperature, and by postures of the body detrimental to its general well-being.

It is incumbent to notice the classification of employments adopted by the late Dr. Farr. It is one that recommends itself by proceeding from so eminent an authority, and by its completeness. In the first place, it institutes six classes, viz.:—1. Professional, 2. Domestic, 3. Commercial, 4. Agricultural, 5. Industrial, and 6. Indefinite and non-productive. These classes are divided into orders and sub-orders, and I might advantageously adopt the classification, did I not desire to make the health aspects of employment a primary principle in their grouping. Nevertheless, the scheme I propose agrees in general outline with the official one; omitting entirely, however, one group of the latter, consisting of scholars and children who do not rightly fall within the category of those of the population this treatise is concerned with.

In his admirable lectures, delivered before the Society of Arts in 1876, on 'Unhealthy Trades,' Dr. B. W. Richardson put forth a 'classification of injuries incident to industrial pursuits,' based on etiological grounds, and having many points of similarity with the one above described. A more elaborate classification is adopted by Dr. Roger Tracy, of New York, who wrote the excellent summary of Industrial Maladies for the supplementary volume of Ziemssen's *Cyclopædia of the Practice of Medicine*, edited by Dr. Buck, of New York. To refer to one other classification, we may note that that of Dr. Ludwig Hirt, in his comprehensive work *Die Krankheiten der Arbeiter*, likewise proceeds on an etiological basis.

Lastly, the Factory Act accepts for administrative purposes a division of occupations into two classes, viz., those carried on in factories, and those in workshops. The division has no scientific value, and is very artificial and arbitrary in character. The self-same occupation, at one place or time,

falls under the designation of factory, and at another of workshop labour, according as the motor-power employed is, or is not, supplied by a gas, or a steam, or an electrical engine; where work is done by any such engine, the place of work acquires the position of a factory. This ruling is the source of many anomalies, respecting which much might be said, but this is not the place for so doing.

The great kindness of Dr. Claud Muirhead, the principal medical officer of the Scottish Widows' Fund Assurance Society, has put me in possession of the experience of that very important office respecting the mortality of occupations, over a period of fourteen years. I gladly avail myself of the statistical facts therein conveyed, but have, at the same time, to guard against an undue use of them in comparative statistics, seeing that they are based upon lives selected, and accepted as profitably assurable after medical examination; whereas other tables, as, for instance, those of the Registrar-General, are founded upon returns made respecting lives of all kinds, good and bad.

Dr. Muirhead has attempted no systematic classification, but been content with the institution of thirteen classes or groups; each including occupations possessing more or fewer health conditions in common. A critical examination of several of his classes at once shows that they comprehend occupations seriously divergent in hygienic features; and this remark applies most strongly to his last, the thirteenth class, designated 'Mechanics,' which contains industries so diverse as those of ship and coach-builders, brass and ironfounders, printers and bookbinders. Yet withal, some of them agree in the main with orders adopted in my classification, and the statistical information conveyed may be advantageously quoted, provided it be remembered that the lives on which it is based are selected lives, and, for the most part, those of occupied persons of the middle and higher classes; since it is to be assumed that the Scottish Widows' Fund Institution, not being an industrial assurance, counts among its members but a limited number of actual working men, small shopkeepers, and clerks below a certain grade. Nevertheless, a high value belongs to Dr. Muirhead's statistics, seeing that they exhibit the experience of the office during fourteen years, and for 5505 male insured.

Another fact to be mentioned is, that in the list of maladies causing death, neither gout nor insanity nor diabetes figures. The last, we presume, is included under the heading of 'Other Diseases of the Urinary System.' As to the other two maladies referred to, their omission is possibly due to their not being registered as the immediate causes of death; though, in respect of gout, the London offices give it a considerable prominence as a cause of mortality. In a special report of the Equity and Law Life Assurance Society on second-class lives, the deaths among gouty lives have been in excess of the expected rate; and it is found that to balance the loss on such lives, an addition of 25 per cent. to the premium is requisite.

Class I. Non-Traders.

I. *Persons engaged in non-manufacturing occupations not immediately connected with trade:* 14 orders :—

Order 1.—*Persons of property and rank having no definite employment.*—This first class of occupations corresponds in general with Order 17 of the sixth class in the systematic arrangement of employments adopted by the late Dr. Farr.

It is by no means homogeneous. In the first place are to be mentioned those who are but the drones and idlers of society, wasting life in indolence or using it only for self-indulgence: and it may seem paradoxical to include such people in an account of occupied persons. But in the apologetic phraseology of the Italians, they are the *dolce far niente* folk, —those occupied agreeably in doing nothing.

Beyond these parasitic offshoots of civilised society, there is a goodly number of persons, particularly females, who, if of no definite calling, find scope for conferring numerous benefits upon their fellow-creatures by engaging in works of philanthropy and mercy.

The class of the unoccupied further contains a very considerable number of pensioners, annuitants, and invalids, whether so from misfortune, old age, constitutional debility, or the consequences of past labour. The presence of such persons in the class under notice is to be regarded as acci-

dental. Unhappily, the list of unoccupied is considerably swollen by the multitude of demented and idiotic and lunatic people. All these stand in the position towards society of invalids. They are accidental additions to the list of the unemployed, consequent upon the invasion of disease.

The order under examination has, unfortunately, received no notice from Dr. W. Ogle. However, his eminent predecessor in office, Dr. W. Farr, published several tables illustrative of the mortality of '*Male* Persons of Rank or Property not returned under any office or occupation,' who at the time of death were 20 years old and upward. Among such individuals there were in all 2082 deaths, of which 365 occurred in persons aged from 55 to 65; 578 in those between 65 and 75; and 666 in others of more advanced years.

Turning to Dr. Ogle's table I., it appears that, assuming the comparative mortality figure to be for all males 1000, and that calculated for occupied males 967, it is in the case of those classed by him as unoccupied males 2182. Looking further, it is seen that while the mean annual death-rate for all males between the ages of 25 and 45, is 10·16, and between 45 and 65, is 25·27; and for occupied males at corresponding ages, is 9·71 and 25·63 respectively, it rises to 32·43 for the former, and to 36·20 for the latter twenty years, in the case of unoccupied males. These figures indicate a heavy mortality among the unoccupied, especially betwixt 25 and 45. But had the vital statistics of females of this class of the community been accessible, I entertain the conviction that the inferences arrived at would be less gloomy, both by reason of the physical and social characteristics of the sex, and of the facts that the ratio of women living to and after the age of 55, surpasses that of males, and that unoccupied females are far in excess.

It might have been supposed that easy circumstances, and escape from toil would promote longevity; but, as seen, this supposition must be discarded. Moreover, the unwelcome conclusion is borne out by Mr. Neison's statistics, which prove that the rate of mortality among the highest ranks of society exceeds that of the population at large, and that the best average life-value and the greatest immunity from sickness are enjoyed by the industrious provident workmen of

the population, who are members of benefit societies. This topic is further handled in Mr. Neison's important work (see pp. 43, 151 and 157).

The explanation of these statistical conclusions appears difficult, and calls for a survey of the entire range of vital conditions of the class in question. It is a very miscellaneous group, as it includes among unoccupied people a large number who have no distinct calling in life, by reason of mental and bodily infirmities, inherited and acquired who seriously raise the mortality ratio. Besides, the average age of those included in it will exceed that of the population at large for equal numbers. For many registered as of no occupation will consist of individuals retired from the labour of early and middle life, on account of advancing years, or of increasing weakness and disease. Still, doubtless, an indolent existence, without purpose, and surrounded by luxuries, is one that fast ripens the seeds of disease and death.

At the cost of slight repetition, it is but fair to add that not a few of the wealthier class, living on their property, are far from being unemployed. Much industry is enforced upon them, and the majority find scope for active exertion in outdoor sports, or in taking part in municipal and magisterial work, if not also in conducting the affairs of the nation in Parliament. Viewed in connection with the latter department of work, they rightly fall within the following order,—"*the governing classes*," and afford illustration of the impossibility of instituting an accurate classification. For accurate vital statistics of the wealthy unoccupied, we must look to those physicians whose practice lies chiefly among them. But we may infer from our knowledge of the mutual reactions of the physical upon the moral nature of man, that the career of such individuals is ever on the advance towards physical, moral and racial degeneration, though it may be retarded by marriage with others of sounder stock. Some light is thrown upon the diseases of the upper classes by Dr. Muirhead's valuable tables (see *ante*, p. 73). His Class I. includes peers, baronets, and those of no profession, all being males and assured. The total deaths in this class were 256 out of 5505, the entire number dealt with. The age of entry on assurance was 39·098, and deaths equalled 62·25, the policy having sub-

sisted on the average 23·543 years. The percentage of deaths to the total in the class is given for each distinctive form of disease, and also the average on the whole number of deaths, the diseases being placed in the order of fatality. One general fact that comes out is, the foremost position occupied by heart-disease as a cause of death. Indeed, its general average per cent. is the highest for all diseases enumerated; and in only six of the thirteen classes does it not occupy the first place in the order of fatality.

I have not space to quote the rate for all the diseases named. Heart-disease and urinary disorders exceed the average most decidedly, particularly the latter; and violent and sudden death, digestive disorders and bronchitis, do so in a lesser degree; but in reference to the long list of other diseases, the average percentage is below that calculated on the entire mortality. That the longevity of the class is good is shown by the fact that, whilst the average mortality per cent. of all deaths ascribed to old age is 4·814, that of this class has been 9·375: in other words, nearly double the number have attained a good old age among its members, compared with all other occupations. The clergy have nearly equalled them in this particular, counting 9·346 in place of 9·375. The percentage of consumption is 8·203 to 9·519 for that of all classes, and that of nervous disorders 8·203 to 11·262. It is a singular thing that neither gout nor insanity finds a place in the list of maladies enumerated.

That this section of the upper classes shows unusual longevity seems contradictory to the results obtained for the unoccupied just now pointed out; but we must remember that Dr. Muirhead's data are founded on assured lives, having an average age of 39 years on their entry. They consequently represent selected healthy lives, and, in many instances, those of employed persons. On the other hand, the mean annual high death-rate of the unoccupied, as set forth in Dr. Ogle's table, between 25 and 45, seems to show that there must be a high percentage of weak and invalid lives in that group which perish early, and for the most part are not assurable.

Order 2. *The Governing Classes.*—This order corresponds

generally with Dr. Farr's Sub-order I., consisting of officers of the national, of colonial, and of local governments. County magistrates are referable to the last of the three divisions mentioned, engaged as they are in the administration of justice and of county business. As before pointed out, a very large proportion of those called the governing classes are to be found in the rank of persons of no definite occupation. Speaking of the members of this order as a whole, they may be described as persons usefully occupied in the services of their fellow-men, and usually under circumstances not detrimental to health and longevity.

Notwithstanding, it is a well-known fact that the duties and responsibilities of the higher offices of Government sorely tax both mental and bodily strength, and that of their occupants not a few break down under the strain, if not permanently, at least for a season. It is noteworthy, however, how considerable a proportion of our statesmen successfully struggle against and overcome the consequences of overwork, both of mind and body—particularly where they have been long and well trained for their duties,—and live long years with full capacity to perform them. Such men may be esteemed as born for their station, and as survivals of the fittest. Only, alas! in their case, in numerous instances, these fittest survivals fail to be the progenitors of an equally fit stock. The remarkable longevity of many public men may be traced to the interlude accorded by official usage, to their exhausting, to the diversion and rest thereby secured, and to the use made of it in active outdoor sport and travel.

It remains a desideratum to obtain reliable statistics for this class of the community, respecting the causes of death prevailing among them, the nature of the diseases common with them, their longevity, and their rate of mortality. Only the analysis of the general bills of mortality made by Dr. Farr is available for use; and according to it the longevity of this governing class is inferior to that of the class having no definite occupation.

It is worth noting, by reason of its influence on the mortality of the governing classes, that the inclusion within the category of colonial servants of the State, will introduce

a certain ratio of individuals, who, from foreign service, have had their health deteriorated by climate, and by exposure to various sources of disease peculiar to tropical, or other climates unfavourable to health where they have served.

What are the prevailing sicknesses of the order in question may usefully constitute the subject of a chapter yet to be written. The popular belief is that gout is unusually common in it; and that a considerable ratio of deaths is due to cerebral diseases and apoplexy. As Dr. Muirhead has not distinguished this class in his paper, we unfortunately can get no help from his statistics.

Order 3. *The Professional Classes.*—In the system of the Registrar-General the professional order includes the governing classes and the army and navy, together with the professions commonly so designated. In my opinion, however, the last-named present characters of their own which justify their separation from the rest. I do not lose sight of the fact that the army and navy are, by general consent, spoken of as professions, but they present features so distinctive that they claim for themselves the position of an order apart. However, when the governing classes and the army and navy have been excluded from the category, there remains an assemblage of occupations of very diverse health characters, and to some at least of which the term professional can only with hesitation be extended.

Firstly, there are three callings to which the appellation 'professions' has been applied from remote antiquity—viz., divinity, law, and medicine. But the changes that have passed over the face of society in the development of other occupations have elevated not a few of them to professional rank. These supplementary professions are instanced in the followers of the fine arts, of science and of literature; the directors of the higher education of the country, engineers and architects; and in the wake of these the practitioners in veterinary and dental medicine, estate and land agents, accountants, bankers, and other dealers in money, and dramatists; and, bringing up the rear, the ambitious professors of dancing, athletics, and fencing, and,

lastly, successful pill-makers who pursue their business under the patronage of the State. Such are the claimants to professional position; and it is in vain to criticise the popular taste which accords the rank to all indifferently who pretend to it. Owing to the narrower views we entertain of the domain of the professions, we have been bold enough to exclude several from the list they aspire to be found in.

Order 3. Section I.—The Clerical Profession calls first for notice. Its health features have been less amply investigated than might have been expected, considering that it has a position so well marked by the conditions of its exercise and environments. Most of what has been done is in the way of mortality statistics, collected from the returns of Life Assurance offices, or gathered by the chief medical officer of the Registrar-General's department from the figures of occupations recorded in the census. From whatever source those statistics have been derived, they all point to the fact that the value of life of English clergymen exceeds that of members of all other professions.

This fact is not difficult of explanation when their social position and surroundings are considered. For the most part, beneficed clergy escape the struggle for existence, can lead a tranquil life, and gather solace and support in whatsoever trials overtake them from the religion they profess. Probably these advantages of their calling are at the present day less pronounced than fifty years ago, before the restless activity in clerical work became a looked-for qualification. It will be interesting to notice, from the returns of the next census, whether the same high ratio of longevity continues.

Dr. W. Ogle says:—'Of the learned professions, and indeed of all the occupations in our table, the Church enjoys the lowest death-rate; its comparative mortality figure is even lower than that of agriculturists, being only 556. Moreover, the death-rates in the clerical profession have fallen considerably since 1860-61-71, and at both of the two age-periods,—viz., twenty-five to forty-five, and forty-five to sixty-five.'

In 1864, the Rev. John Hodgson, Secretary of the Clergy Mutual Assurance Society, published his 'Observations in

reference to the Duration of Life amongst the Clergy of England and Wales,' and very recently the directors of that Society have issued an excellent summary of its mortality experience from 1829 to 1887. The conclusions arrived at by Dr. Ogle are fully supported by this document. Thus, it is noted that the actual number of deaths of its members,—for the far greater part clergymen,—was but slightly more than two-thirds the number expected according to the Carlisle table. and the Institute of Actuaries' tables. Again, 'under the age of fifty, the mortality among the laymen and females (of the Society) exceeded that among the clergymen.' However, that of laymen above fifty, and of females between fifty and seventy, was lower than among the clergy; 'while over the age of seventy the mortality of females exceeded that of the other two classes.'

Respecting the longevity of ecclesiastics, we also have the observation of Dr. Farr, that Protestant ministers and Catholic priests experience low rates of mortality from ages of twenty-five to forty-five, but that after the age of fifty-five the mortality of Catholic priests is high; 'perhaps' (he adds) 'the effects of celibacy are then felt.'

The diseases of ecclesiastics incident to their calling are few in number. The best known is the affection of the fauces and larynx, styled 'clergymen's sore throat,' dependent on excess of speaking, and particularly on the bad habit of reading and preaching in a key unnatural to them. Of other maladies, the incidence of which they share with the general public, the best account met with is that of Dr. W. H. Stone, the late medical officer of 'the Clergy Mutual Assurance Society,' appended to the report previously referred to. I borrow from it the following particulars.

To show that the experience of the office is highly satisfactory, Dr. Stone selects two or three prominent diseases. Phthisis, for example, during the period of thirty-eight years, produced only 5·3 per cent.; albuminuria, 3·8 per cent.; whilst nervous diseases caused 22 per cent. of the total number of deaths. Of the 466 deaths assigned to the last cause, 255, 'or more than one-half, were at ages over sixty.' The cause of death following next in order 'depends most naturally upon the respiratory and circulatory organs, which

stand respectively at 382 and 315 deaths,' out of the entire number, 2119. 'Next to these stands the somewhat vague and diffuse class of diseases of the digestive system, which accounts for 217 deaths. . . . Diseases of uncertain seat stand at 167. Very close upon these comes natural decay, with 133 deaths, at ages chiefly between seventy and ninety.' Bronchitis caused only 134 of the 2119 deaths, and those for the most part at late periods of life, unlike phthisis, which developed chiefly between the ages of thirty and forty-nine. 'It is probable that the low ratio found for phthisis should be raised by the addition of the hæmoptysis and hæmorrhage cases,' as returned in the tables. 'The vague term *angina pectoris* accounts for 34 deaths, whilst diseases of the liver and other digestive organs show a very low mortality.' On the other hand, diabetes presents a rather high figure, 'but almost all of these cases occurred in the later period of life—namely, between fifty and sixty-nine.'

Passing by some other groups as not calling for remark, Dr. Stone reaches the eleventh, comprising 'violent deaths and accidents,' and observes that 'for a society insuring the lives of men of regular habits, and living in a tranquil condition (the returns) are exceptionally heavy, there being no less than twenty-nine deaths by accident, ten by drowning, two murdered, and seventeen by acknowledged suicide.'

Epidemic and infectious diseases produce fewer deaths than in the community at large, with the exception of pyæmia; and cancer figures for only 102, and general paralysis for twelve deaths.

Turning to Dr. Stone's appended tables to learn the ratio of deaths attributed to mental disorder, we meet with a good example of the loose way in which the causes of death are returned. Thus, we find insanity put down for five deaths, and mania for four; whereas the indefinable lesions expressed by the terms diseases of the brain, softening, etc., stand at 138. To calculate the number of the deaths from mental disorder, a considerable proportion of these miscellaneous deaths would have to be added to the number assigned to insanity.

In all, there are found 159 of the grand total of 2119

deaths from all causes together due to cerebral lesions; representing the ratio of rather more than 7 per cent.

According to Patissier, Catholic priests are liable to hernia from over-much chanting and repeated genuflexions.

Parchappe, who gathered his statistics from the returns of French asylums, placed ecclèsiastics third in order among professional men in liability to insanity, they being surpassed in this respect only by artists and 'jurists.'

In Dr. Muirhead's recent returns, clergymen are grouped as Class 10. The figures show that they attain a greater longevity than any other body of men, excepting those of his first class, 'peers, baronets, no profession.' Heart-disease takes the first place as a cause of death; in no other class is the percentage so high, for it equals 17·134, whilst the average or total general mortality is 12·879. Diseases of kidneys and of the urinary organs produce an excess,—the former being 6·231, in place of 4·269; and the latter 4·984, instead of 3·615. Bronchitis has a less percentage, and the same holds good of consumption,—viz., 4·673 to 9·519. Cancer percentage is 7·165, as contrasted with the average 4·977. Nervous diseases follow next after heart disorders in the order of fatality, but their percentage very slightly exceeds the general rate. The variations of other maladies are small, and all in favour of this class of the assured. The ratio of mortality from heart-disease is remarkably high, exceeding the rate, 14·8, experienced in the English Clergy Assurance.

The general result is thus put: 'Deaths, 321; duration, 25·724; age at entry, 39·099; deaths, 64·491.'

SECTION 2.—*Legal Profession.*—There is a greater variety, both in their incidental and accidental conditions, between the several grades of this profession, than betwixt the different orders of the clergy. Moreover, the mental and bodily wear and tear—especially the former, is vastly greater; and in the case of barristers, there is required, for success and for reaching the highest positions in their calling, not only vigour of mental faculties, but also physical strength and powers of endurance. The spur of ambition is often an incentive to overwork, whilst disappointment too often follows the best

endeavours, and is a precursor to broken-down health and early death. The health conditions of the profession of the law are so well known as to require no elucidation; but after a consideration of them, it will not be surprising to learn that the value of lives of barristers is considerably under that of the clergy, and that of solicitors yet lower.

Dr. Farr says 'solicitors experience the full average mortality after the age of thirty-five; the legal work is hard.' According to Dr. Ogle, the comparative mortality figure for the legal profession is 842, whilst that of the clergy is only 556. And, it is added, 'the death-rate in the earlier age-period (twenty-five to forty-five years) has fallen from the previous record, while the death-rate in the second age-period (forty-five to sixty-five years) has gone up; changes which, as already pointed out, are common to a very large proportion of the occupations.'

It is a matter of common observation that many members of the legal profession survive to an advanced age; particularly those who attain its highest positions. We have not facts to show how many who started with them on the same career fell in the race; but it may safely be concluded that the fortunate survivors are in no small degree indebted for success to original conjoint endowment of strong mental and bodily power; and in Darwinian phraseology are 'survivals of the fittest.'

Overwork, mental strain, and anxiety are the obvious causes of illness most in operation; their effects will vary according to individual qualities and tendencies, and to accidental surroundings, of which confinement in rooms and courts, frequently ill-ventilated and crowded, is the most prominent.

If Parchappe, as already quoted, be right in his statistics, the practitioners of the law in France exceed, in the ratio of mortality they bear to the population, all other professions excepting artists; the percentage of the two being respectively 8·41 and 9·60 of the insane in the country.

Dr. Muirhead's table of the order of fatality in various callings supplies the following facts respecting lawyers, taken together with accountants and bankers. Heart-diseases exceed the average for all occupations, clergymen excepted,

nervous maladies come second, and apoplexy third in order, each showing a slight excess percentage. As happens with clergymen, the lawyers have a high percentage of deaths from renal and urinary diseases, and from cancer; bronchitis, moreover, shows a slight excess, whereas consumption falls considerably below the average, being 6·546, in place of 9·519. With respect to all other disorders enumerated, their percentage is below the calculated rate. As deaths from old age are 6·772, compared with 4·814, it implies that a larger proportion of the legal profession live to advanced ages.

The duration after insurance equalled 26·325, the average age at entry was 36·673, and deaths 62·676.

SECTION 3.—*The Medical Profession.*—*Medical men* are most diversely situated with regard to health conditions. It is the lot of many to struggle through life earning, by much labour and anxiety, a meagre livelihood for themselves and families. Fortune smiles on another smaller section, and favours them not only with competency, but with wealth. However, these favoured ones are occasionally victims of too great prosperity in practice, and succumb to disease and death in the height of their career. And, taken as a whole, the medical profession occupies a less favourable position in mortality tables than do the clerical and the legal.

Thus Dr. W. Ogle calculates, from the data at his disposal, that the mortality figure, instead of being 556, as in the case of the clergy, and 842 in that of the lawyers, reaches to 1122, which is precisely the same figure as that for slate and stone quarrymen, whose occupation is ranked among the most unhealthy.

Dr. Ogle followed up his statistical investigations, and published the results in an exhaustive communication to the Royal Medico-Chirurgical Society in 1886 (*Transactions,* vol. lxix. p. 217). Briefly stated, they are, that the annual total death-rate equals 25·3 annually to every 1000 medical men; and represents an increase at all ages above Dr. Farr's calculations. This rise has happened with regard to the later ages, forty-five to sixty-five. On the other hand, the rate has diminished for the earlier decenniads, though not in the same

high proportion. A similar increase and decrease occurred also in most occupations, though in a reverse order.

Respecting the heavy death-rate of doctors, Dr. Ogle found that, in only seven of twenty-seven causes of death registered, is the medical death-rate lower than that of the male population at large. Of the seven, three only are of importance, viz., phthisis, diseases of the respiratory organs, and accidents. With respect to phthisis, the medical mortality is forty-five below that of the whole male population: and, with regard to respiratory lesions, it is twenty-seven below.

The advantage they exhibit in reference to phthisis is assignable to their better social surroundings as contrasted with those of a large body of the general male population, which suffers by destitution and other causes of decay. The ratio of hernia among doctors equals thirteen, as contrasted with eighty-eight of males at large; whereas that of liver diseases, of alcoholism, of calculus, of urinary maladies, diabetes, and of malignant diseases, attains a higher figure in their case. Moreover, leaving out of sight those occupations notoriously dangerous to life, the proportion of accidents among medical men ranges higher than with the remaining entire male portion of the community. The same holds true of suicide; for whilst 238 per million living of the general population perish thereby, the corresponding figure for doctors is 468, that for the clergy 123, and that for barristers and solicitors 354.

In conclusion, he calculated the average duration of life in the medical profession to be 59·3 years.

With the view of further elucidating the longevity of medical men, I abstracted from the obituary lists of the *Medical Directory* the returns made of the ages at death during a period of six years, not consecutive. The outcome is that of the 1645 deaths recorded, there were between—

20	and	30, 131	deaths,	or	7·96	per	cent.
30	„	40, 206	„	„	12·52	„	„
40	„	50, 243	„	„	14·77	„	„
50	„	60, 222	„	„	13·49	„	„
60	„	70, 333	„	„	20·54	„	„
70	„	80, 331	„	„	20·01	„	„
80	„	90, 162	„	„	9·84	„	„

From these figures this much follows, that by the time the sixtieth year is attained, just upon fifty of every hundred medical men who have qualified, have been swept off.

Of the illnesses fatal to doctors, a few pregnant observations appeared in a letter to the *Lancet* (February 14, 1891, p. 393), from Dr. Claud Muirhead, the principal medical referee of the Scottish Widows' Assurance Office. His data are derived from assured lives. He writes to this effect:—A large percentage (as in common with others assured in the society) die of diseases of the heart and nervous system. A large number succumb to pneumonia, nearly double of other insurers. The same applies to enteric fever and other zymotic diseases. More than the average come to an untimely end by violent and sudden death; causes to be viewed as incidental to the profession. Consumption equals only one-third of the total average of deaths from this cause.

Dr. Muirhead's lately-received tables illustrate the truth of the general statements made above. Heart-disease stands first in the order of fatality, with an excess of slightly more than one per cent. above the calculated rate. Nervous diseases exhibit a shade of excess, and pneumonia an exceedingly large one, viz., 11·290, compared with 6·848. Curiously enough, bronchitis has a somewhat smaller ratio than that found for all occupations, whilst consumption is represented by 3·629, as contrasted with 9·519. Unlike what happens with clergymen and lawyers, diseases of the 'urinary system' and cancer are under the average, whereas zymotics and enteric fever are both rather more than ten per cent. instead of 6·140. A somewhat higher longevity belongs to doctors than to people at large; the average deaths from old age being 5·242, in place of the general average 4·814.

The most striking results of the table are, the great excess of deaths from pneumonia and zymotics, and to these two must be added violent and sudden deaths (6·049 to 4·723), and the low percentage of consumption.

The age at entry on assurance was 35·299, and that of death 55·871, the duration of policy being 20·891.

Dentists and veterinary surgeons constitute two supplementary groups of the medical profession; each, however,

having health conditions different from the other as well as from those of the medical men. What their several vital statistics may be, I have no means of ascertaining.

SECTION 4.—*Other Occupations of a Professional Character.*—Besides divinity, law, and medicine, the other and various occupations to which a professional status is accorded have little in common, saving the preponderance of mental work attendant on their pursuit. Respecting college professors and lecturers, it is to be remarked that many of them would come within the category of clergy, or lawyers, or medical men, in consequence of the training undergone and the degrees they hold.

Engineers and architects constitute a section of workers intermediate between scientists and mechanicians, though with closer relations to the former as brain-workers.

Bankers, stock-brokers, and other dealers in money, as claimants to professional rank, differ in no substantial particulars from merchants dealing in less valuable commodities, so far as health aspects are concerned.

Under the name artists, a very mixed body of workers is comprised. This is especially the case in regard to French statistics. For those acquainted with French usage know how widely and loosely the appellation artist (artistes) is bestowed in France; being applied to designers of dress, to hairdressers and wigmakers, and persons engaged in other employments of ordinary business character, as well as to musicians of all sorts, public singers, ballet dancers, fencing masters, actors, and actresses. And the conviction will arise that it is due to this wide extension of the meaning of the term, and to the inclusion of a large proportion of people whose avocations are fraught with injurious consequences, that the percentage of deaths among artists noted by French authors is so high.

From this general sketch of occupations claiming, rightly or wrongly, to be esteemed professions, it will be apparent that no general statements of their sanitary conditions can be advanced. The course taken, therefore, will be to relegate several of them to chapters on trades; and to distribute others in various sections in connection with any special bodily peculiarities that attach to their pursuit.

Dr. Muirhead has constructed a class of lives which includes 'merchants, manufacturers, warehousemen, men retired from business, brokers, and commission agents.' The connecting bonds between these several classes of people are not remarkably clear and definite. The conditions attending the exercise of their several callings are far from uniform. However, it is worth while to record some of the averages of diseases that appear in the list intended to show their comparative fatality.

Heart-diseases stand first, with an excess of four per cent. above the general average. Nervous diseases, apoplexy, consumption, diseases of the liver, those of digestive organs, bronchitis, and renal diseases, follow in the order of their enumeration. Diseases of the liver and of the kidney are the only two that exhibit a figure above the average, and that only to the extent of about one per cent. Consumption stands fourth in order with an average of 8·009, as compared with the normal 9·519. Old age, as the cause of death, has sunk from its position of third among clergymen, and seventh among medical men, to the tenth place in the table of mortality percentages; indicating that longevity in the class in question is inferior to that found for the two professions named. The general compendium shows, 'deaths, 1099; duration, 21·875; age at entry, 37·509; death, 59·038.'

Dr. Muirhead's twelfth class may be here considered in relation to the statistics of prevailing diseases. It is headed 'Other Professions,' and comprises 'engineers, surveyors, architects, teachers, students, artists, coal and iron masters.' In the order of fatality, heart-disease has lost its pre-eminence, so general in most callings, and is reduced to the fourth place; this being the lowest point it reaches in the whole series of tables. Those nearly approaching this lower level are clerks and shopkeepers. On the other hand, nervous disorders usurp the first place, consumption takes the second, and apoplexy the third; each of these three having a percentage above the estimate, whilst heart-disease is more than four per cent. below it. Other maladies showing an excess are, bronchitis, diseases of the liver, and typhoid fever, and, in a less degree, pneumonia, diseases of urinary organs (as distinguished from kidney lesions), and diseases of the

digestive organs. Old age has fallen to the ninth in rank, and is below the average.

The compendium attached to the list is:—'Deaths, 533; duration, 19·608; age at entry, 36·227; death, 55·480.'

ORDER 4.—*Army and Navy.*—These public services are always held to be professions, and they are marked out by strong characters from other professions and occupations. Moreover, the social differences between the several members of either service, the differences also in the duties befalling them and in the amount of work required, taken in conjunction with the perfect organisation given them, impart to those services the character of a special population, living under special laws and under health conditions peculiarly its own.

The examination, therefore, of the sanitary features of the army and navy as occupations, constitutes a study so wide, that even an abstract of the conclusions arrived at by medical men and statisticians would occupy undue space in a treatise dealing with the whole range of occupations, but primarily with those of civil life.

Besides this, there exist several works on military and naval hygiene, written by experienced officers in each service, which so occupy the ground, that the observations of a writer having no practical acquaintance with the subject, would be, at the best, superfluous. In thus referring to what has been accomplished by others, we must not be unmindful of the many excellent contributions made by the late Dr. Gavin Milroy, by whose thoughtful liberality the Royal College of Physicians of London was enabled to establish the Milroy course of lectures on subjects relating to public medicine and epidemiology.

Mental Labour in Professions.—The three 'learned' professions have this in common, that the labour attaching to them is primarily mental. This circumstance taken alone, cannot be charged with injury to health. Experience shows, by the history of mathematicians and philosophers, metaphysicians, and others, how intense and continuous may be brain-work without damage to health. This is true of pure science and abstract thought; but in proportion as intel-

lectual effort becomes intermixed with human interests and human passions, does it lose its innocuous characters, and, when too prolonged, lead to mental prostration and disturbance.

The clerical profession, which is most exempt from this intermixture, stands, as already seen, foremost of all occupations in life-value. Legal practitioners are brought into close relation with the affairs of other people, and, for the most part, with those of serious moment, affecting life or reputation or property; and consequently in conducting them, they cannot escape responsibility and anxiety, or, what is worse, worry. Solicitors are more exposed to this complication, for, although barristers may undergo more intense intellectual labour, and be liable to greater emotional strain, yet this is not lasting; for when the case is argued out and a decision arrived at, counsel is relieved of further anxiety and thought about it.

This escape from anxiety and responsibility is not enjoyed by the medical man, who cannot throw them off until recovery is complete, or till death removes his client, and even not then completely. The management of a case of serious sickness is a daily or hourly tax upon the mind of a physician; not only in the treatment of the malady, but in dealing with the peculiarities and the personal requirements both of the patient and of his friends. In short, the feeling of responsibility is incessantly forced upon the doctor, and he is held accountable for issues beyond human control. Life or death, recovery or lasting infirmity, are the weighty matters weighing upon his mind, and, consequently, it can be no subject for astonishment that the mortality of doctors ranges far higher than that of the other professions. To all this must be added the larger amount of physical exertion demanded of them, and the far greater exposure to the inclemencies of weather. Many country solicitors have a fair share of travelling, but they have usually control over the time and manner of undertaking it; quite otherwise is it with medical men.

Another incident of the medical calling is the almost daily exposure to infectious and contagious diseases, which are known to prove fatal to many of its members, particularly the younger. And finally, accidental evils attend medical

students in the dissecting rooms, and practitioners at large when required to make autopsies or deal with tainted lives.

Lévy, in his observations on those devoted to intellectual work, assumes that this work implies hyperæmia of the brain, predisposing to apoplexy; and, to support his hypothesis, cites the names of several distinguished men of letters and science as having perished by apoplexy. There is a certain measure of truth in the hypothesis, but for its demonstration something beyond an appeal to the histories of a few eminent individuals is needed. What is required is a searching investigation into the life-history of a large number of men occupied in intellectual pursuits, taking into account all the collateral circumstances co-operating with cerebral activity; particularly those of an emotional character, represented by worry, anxiety about the means of living, disappointment, a sense of responsibility; and besides all these psychological factors, the natural constitution and temperament; in short, the surroundings of life, both official and domestic.

To elucidate the effects of enduring and strong intellectual effort, within certain limits of age, upon the bodily functions, the same writer quotes the medical statistics of the École Polytechnique of Paris, observing that the pupils pass two years in the institution unremittingly engaged in advanced studies, and subjected to frequent examinations. And besides this, their presence in the school implies serious preparatory study for admission. He adduces the statistics for three years, in the case of 586 students who have within that period passed through the school, which show that 425, or 72·05 per cent., required treatment in the infirmary; 650 suffered some slight indisposition,—that is, 111·00 per cent.; and two died, equal to 0·52 per cent. The maladies that affected the youths in question were, in the case of 290, those of the gastro-intestinal track; in 120, of the respiratory organs, including 107 of acute bronchitis, two of hæmoptysis, and two of phthisis. Again, 360 pupil patients were treated for cerebro-spinal derangements of various degrees of severity, comprising 104 cases of cephalalgia, 5 of migraine, 60 of general nervous excitement, and 23 of local neuralgia; 52 of headache with congestion, 91 of general malaise without,

and 12 with fever, and 3 of nervous palpitation. This list points to a great frequency of headache and like disorders, in fact, to nearly the half of the entire number of invalids.

This may be an unusual proportion in a company of youths; yet without doubt prolonged study is a cause of cranial pain. We, too, must remember how common cephalalgia is in growing youths where it cannot be ascribed to study, and how many are its causes other than intellectual effort. Before dismissing M. Lévy's painstaking observations, it may be added that he traces to over-mental work a deteriorating effect on the growth of the body. Thus, he found that of 280 pupils who had reached their twentieth year, sixty-seven were beneath the average height of young men of that age. In connection with these particulars, it would be well to read Dr. Hertel's excellent work on *Over-pressure in High Schools in Denmark*, and Sir J. Crichton-Browne's remarks on the same subject, printed as a Parliamentary paper.

The preceding remarks apply not only to members of the three learned professions, but also to those occupying high positions in science and literature, in engineering and architecture, in finance, and in conducting the higher education of the country. Those, again, who are devoted to art and imaginative literature are subjected to strong mental effort, which, too, in their case, involves that of the imagination, and, to some extent, of the emotions.

The question here arises: In what degree are intellectual workers subject to mental disorder and cerebral lesions? Do they suffer more than mechanical toilers? To this query I have not met with a satisfactory reply. The data for an answer are not at hand. Those obtainable from asylum statistics are not competent to solve it. Pauper asylums, which present the widest field for statistical inquiry, unhappily contain examples of lunacy from every profession. But their returns do not help to discover the ratio of these patients to the whole number of individuals engaged in the profession they severally belong to. Besides, we do not know the number of professional men in confinement outside asylums. But that there is a proclivity to nervous diseases is proved by Dr. Stone's evidence, that among the clergy 22 per cent. of the total deaths were due to them.

ORDER 5.—*Officials of the Public Civil Departments.*—In this section the highest class of public functionaries are not included, but only those employed under them. The former fall under one or other of the preceding sections,—the governing or the professional classes. Neither does it embrace clerks, whether employed in Government or municipal offices, for these employés have the like health conditions with clerks generally, except that probably their hours of work are shorter, and that they can secure to themselves more leisure and superior social advantages.

The public departments at present had in view are: Excise and customs, the post-office, and the police.

If the health of the community be a primary subject for the attention of the Government, and the knowledge of vital statistics of social, economical, and political importance to the State, it would be to the credit of the Government of this kingdom that the vital statistics of those engaged in all the great public departments of the State should be rendered available for public use. Full and most instructive reports of the Army and Navy are annually issued, but none of the Post Office servants, and none of the officers of excise and customs. Formerly, the yearly report of the Inspector of Customs was printed, but the straitened state of the Exchequer, as we must suppose, compelled the cessation of their publication. As to the health statistics of the Post Office employés, they are kept shrouded in mystery by the officials, although they would be of the highest interest to sanitarians and medical men. I allude particularly to the telegraphic department, where electrical machines are so extensively used; for it is not unlikely that some special facts would come out from an exhaustive examination of the health of those constantly using such instruments.

In Continental countries investigations of the hygienic results pertaining to all branches of the public service are facilitated, and the lessons therefrom utilised in favour of the public health.

The hygiene, maladies, and mortality of officers and men in the services of our railway companies is another subject to be worked out. As hereafter seen, I have collected a few facts respecting it.

A. *Custom House Officers.*—By the great kindness and courtesy of Dr. Dickson, the Medical Inspector of Customs, I am able to present some valuable particulars and statistics concerning the officers of that department. Dr. Dickson's contributions are contained in a paper read before the British Medical Association in 1875, entitled, 'On the Numerical Ratio of Disease in the Adult Male Community,' and in the Inaugural Address, delivered by him as President, before the Epidemiological Society at the commencement of the session 1885-86.

His predecessor in office, the late Dr. M'William, between 1856 and 1861, published a brief yearly report 'On the Health of the Water Guard and Waterside Officers of Her Majesty's Customs.' This useful example was followed by Dr. Dickson for twenty-one years, from 1862 to 1882, when, for some reason not stated, his reports were no longer included in the official Blue-book, and the public were deprived of the rich fund of information contained in them.

I will now bring together the facts contained in the two essays above named. Dr. Dickson informs us that the number of subaltern Custom House officers under his medical charge are about 1000 in number, and, on reviewing their health conditions, concludes that they form a very fair type of the average adult male population of the middle class of life. Their ages range from twenty-five to sixty-five, and they are employed from eight to twelve hours a day in duties of varied character, which in many instances involve considerable labour and exposure to the weather. One-fourth of the force is located at Gravesend, where most of their time is spent on board the ships they have to examine and watch. The London section, for the most part, live in the southern and eastern suburbs. They are arranged in three divisions,—outdoor officers, watermen, and messengers. The watermen are exposed to extreme vicissitudes of temperature. All are medically examined before being admitted to the service, and passed as healthy men of fair physical strength. Owing to no fresh appointments having been made for several years, the mean age of the force has risen from thirty-three to thirty-eight years. The mean daily number incapacitated for duty by reason of sickness or

accident has been 29 per 1000, and the ratio to the mean strength of the force has been 700 per 1000. 'These figures,' says Dr. Dickson, 'demonstrate a very satisfactory state of health of the department, when the age, duties, and peculiar circumstances of the Customs officers are taken into consideration, and will compare favourably with the considerably younger men of the Army and Navy serving in the United Kingdom.'

The entries on the sick-list are swollen by the two circumstances—(1) that medical attendance and medicine are supplied them free, and (2) that for six months they may be relieved from duty without loss of pay. These facilities for treatment render the loss of life from acute disease comparatively rare, and, at the same time, help to retard the downward course of chronic maladies.

'The mortality from disease has ranged from five to eighteen *per annum*, and shows for the twenty-eight years an annual mean death-rate of 11·5 per 1000. Deaths from accident have averaged annually 1·3 per 1000. Deaths from all causes have in the period amounted to 12·7 per 1000.'

The experience of the Customs department furnishes another example of the manner in which conditions of employment, even when these have a general similitude, variously affect statistics. Thus, as Dr. Dickson points out, in the Army, Navy, and Customs forces, mortality and invaliding cannot be dissociated. For instance, it happens that many of the cases invalided for phthisis, etc., terminate in no long time in death; and, in the military service, such cases are discharged at a comparatively early period. 'In the Customs force it is different; persons afflicted with chronic diseases often being able to continue at some light duty for many months, with occasional absences in severe weather, and so to defer death or superannuation for a considerable time, in like manner to the bulk of the civil population.'

Referring next to the numerical proportion of the various classes of disease, Dr. Dickson found the class of zymotics to have 'a ratio of 6 per cent. of the total number of cases, 6·1 per cent. of the whole time lost by sickness, 7 per cent. of the entire mortality, but no superannuation. The constitutional

class yield a ratio of 18 per cent. on the number of cases, 26 per cent. on the time lost by sickness, 40 per cent. on the whole mortality, and 49 per cent. of the superannuation.'

Of this class the most important are rheumatism, gout, and phthisis. The two former together 'constitute 13·5 per cent. of the number of cases, and 14 per cent. of the time lost by sickness. They show an infinitesimal proportion of mortality, less than 1 per cent., but no less than 32·7 per cent. of the whole amount of superannuation.' In a word, rheumatic affections were the cause of disablement and abandonment of employment in just upon one-third of the whole number superannuated.

'Phthisis yields 1·4 per cent. of the number of cases, and 8 per cent. of the time lost by sickness; 31 per cent. of the whole mortality, and 9 per cent. of the superannuation. . . . Diseases of the respiratory organs yield 27 per cent. of the cases treated, and 20 per cent. of the time lost; 11 per cent. of the whole number of deaths, and 17·7 per cent. of the superannuations. Including phthisis (which in the great majority of the cases that occur in this body of men, may be considered as a local pulmonary, rather than a constitutional disease), the maladies affecting the lungs and air-passages yield the large proportion of 28·4 per cent. of the cases, 30 per cent. of the time lost by sickness, 42 per cent. of the whole mortality, and 27 per cent. of the superannuation.'

Diseases of the heart and great vessels caused 13 per cent. of the deaths, but only 1 per cent. of the cases treated.

Of diseases of the digestive organs, those of the liver and dysentery are the chief causes of death. Taking a period of twenty years, 18 cases of dysentery happened in the first ten, and only nine in the second. Diarrhœa is a summer disorder, associated with rise of temperature and errors of diet. In 1866 it prevailed epidemically at the same time as cholera, and 65 cases occurred, several of choleraic form, yet only one man got cholera, although 600 of the force then resided in the Tower Hamlets, where the epidemic was most fatal. Dr. M'William alludes to diarrhœa prevailing in the third quarter of the year; and in 1858 to the stench of the Thames, which, however, in his opinion, exerted no prejudicial influence upon the men.

Typhus seems to have disappeared since 1870, and relapsing fever since 1869, whilst diphtheria has been unknown in the force for twenty-eight years.

Urinary diseases produced only 2·4 per cent. of cases, and 2·6 per cent. of deaths; cutaneous and cellular diseases 11·5 per cent. of cases, but no deaths; whilst injuries constituted 10 per cent. of the cases disabled, and 11 per cent. of the whole time lost in illness by the force. Deaths from violence form 9·5 per cent. of the entire mortality. Cancer and diabetes are very rare.

Thus, pulmonary and rheumatic affections are accountable for nearly one-half of the deaths, and rheumatism and gout together for one-third of the whole number superannuated for disability. Gout caused an average of 6 per cent. of the cases treated, and prevailed most among the watermen. Its 'attacks seem to be irrespective of age or personal habits; often most severe in abstemious men; but, in the majority, gout is of hereditary origin, and very remarkably influenced by weather,' especially when this changes from dryness to humidity and warmth.

SECTION B.—*Police Force.*—By the personal kindness of Mr. Timothy Holmes and of Mr. Gordon Brown, I am enabled to give a statistical outline of the sickness and mortality of the Metropolitan and of the City of London Police forces.

I will commence with an analysis of Mr. Holmes' reports, made during his term of office as chief surgeon. These reports extend over a longer series of years, but I have considered it sufficient for my purpose to take the last ten years, ending in 1884, when Mr. Holmes resigned his post, and since which date I cannot ascertain that any further reports have been printed.

By way of general introduction, it is to be remarked that the police, as a body, represent a distinct class of occupied people, selected, in the first instance, as examples of men of good bodily and mental health and growth, charged with special duties, not often demanding muscular exertion, but of a responsible character, and involving great exposure to weather, as well as their presence in crowded police courts, and visits to the most unhealthy and often infected localities.

To these conditions must be added exposure to the violence of crowds and of individuals; to the dangers of attendance at fires; night duties, and often irregular meals: standing, or walking a monotonous pace for hours, many annoyances and some temptations.

This array of conditions of employment is suggestive of the production of diseases of exposure, of the frequent occurrence of injuries, and of irksomeness and vexations which will afford grounds for resignation, and are further contributed to by the exigencies of discipline.

The circumstances of employment both of the Metropolitan and of the City Police are in all essential points alike. The latter force possesses the great advantage of having a special hospital, to which every man who becomes unfit to continue his duties is at once sent. Consequently, the returns of that hospital exhibit a large proportion of slight cases of illness or of injury, whilst early treatment likewise must diminish both the duration and the fatality of severe maladies.

In both services vaccination and re-vaccination are diligently enforced, with well-marked good results, scarcely any police-officer having caught small-pox even when that disease has prevailed epidemically.

Metropolitan Police Force.—Taking up Mr. Holmes' excellent reports, we find that the average daily percentage of sickness for the ten years examined has been 3·02 per cent., and the death-rate per thousand 5·2. The latter shows a tendency to decline. In the course of the ten years the force grew from 10,093 to 12,424. The group of affections headed 'diseases of exposure,' includes rheumatism—chronic and muscular, coryza, bronchitis, and tonsillitis. Coryza presents the highest number of cases; after this follow rheumatic affections, then tonsillitis, and last, bronchitis.

Mr. Holmes very rightly animadverts on the looseness of the term coryza as officially employed, remarking that it is made use of to express all maladies so beginning, but which may eventually develop into broncho-pneumonia or other severe thoracic mischief. It will presently be noticed that Mr. Gordon Brown reckons catarrhs of the throat to be one of the commonest maladies of the City Police.

Rheumatism is very rife, and yet the returns of sickness show comparatively few cases of acute rheumatism and of cardiac disease. Bronchitis does not cause so much illness as might be expected, but I imagine that a certain portion of the so-called cases of coryza are referable to it. As might be expected, the diseases of exposure augment in number in the months of winter and early spring; though tonsillitis shows but little variation according to the season; in December alone does it pass above the monthly rate. The sum-total of these maladies exhibits but small variations from year to year, notwithstanding the progressive increase of the force.

As to the causes of death, it is found that phthisis was answerable for 33·7 per cent. of the whole mortality: pneumonia and pleurisy for 8·2; bronchitis for 6·9; heart-disease for 8·0; cerebral lesions for 7·3; hepatic for 2·6: renal for 3·3: typhoid fever for 5·5; and injuries for 5·3. Rheumatic fever did not appear in the list until 1876, since which time it has been the cause of death in about 2 per cent. of the entire mortality.

Of the 2570 instances of discharges and of invaliding for sickness and unfitness, rheumatism has furnished 19·3 per cent.; long service and debility, 23·4; phthisis and diseases of the lungs, 13·07; bronchitis and asthma, 6·2; insanity, 2·8; varicose veins and ulcers, 2·2; cerebral affections, 2·7; heart lesions, 4·8; deafness, 1·4; eye weakness and diseases, 5·2: gout, 1·6; and liver only 0·7 per cent.

The proportion of annual discharges and dismissals and deaths has tangibly declined during the latter five years of the decenniad. Instead of being equal to one-ninth of the whole force, it is reduced to one-eighteenth. Still it is a feature of the police force that it is a shifting body of men, a circumstance that must greatly affect the reading of its statistics.

Besides varicose veins consequent upon long standing and walking, policemen suffer greatly from soreness of feet, for which invaliding is required, and in a less degree from weakened knees and ankle-joints, and flattening of the arch of the feet, which become causes of unfitness and discharge.

City of London Police Force.—The painstaking extended

statistics of Mr. Gordon Brown, the surgeon-in-chief of the City of London Police Force, may now be examined. On comparing them with those of Mr. Holmes, we may observe on one hand an entire agreement, whilst on another there is considerable divergence. Catarrhal disorders from exposure rule equally high in the two forces, and acute rheumatism with heart-disease presents a small ratio in both; whereas gout and rheumatic gout, which Mr. Brown finds so wide-spread among his men in the Metropolitan force, figure for no more than 1·6 per cent. of the total discharges and dismissals on account of infirmities and sickness. Is the explanation to be had from the more festive character of the City population and the more liberal victualling of their protectors?

In the total of 19,311 men belonging to the City force who served between June 1866 and June 1890, 'the diseases' (writes Dr. Brown) 'most prevalent were catarrhs of the throat and lungs, rheumatism and gout, varicose veins, flat feet, and kidney disease.' He adds, 'Varicose veins and ulcers of the legs, or loss of the arch of the foot, producing pain in walking, arise from much standing. Gout is decidedly our great enemy, attacking many men who are abstainers, as well as some who live freely; in fact, I have no doubt that the quantity of meat, and perhaps, I may add, of beer, with exposure, are the chief cause of this disease after thirty-five or forty years of age. Tonsillitis associated with gout is also of frequent occurrence, and also albuminuria with contracted kidney.'

On the question of the production of gout, Mr. Brown, as an officer of the service and interested in its credit, may be presumed to speak with delicate caution. Our own knowledge of policemen and their ways, of the ever active inducements to slake their thirst at the cost of the dealers in beer and spirits, lessens the marvel of the prevalence of the disease in question among them. Their yielding to temptation may produce gout without any outward and visible signs of their liking for liquor; and they can, and do pass through their career as temperate and sober men, for undoubtedly they acquire remarkable tolerance of the beverage so frequently patronised.

Our observations apply primarily to the smaller forces belonging to provincial municipal bodies, whose position is more stationary, and consequently affords better opportunities for social amenities among the inhabitants than fall to the lot of larger bodies, such as metropolitan and county police. However, it is well to recall the fact, that a like prevalence of gout is found among custom-house officers. And here, again, it is the men brought into most intimate connection with the crews of ships, and supposably with fuller opportunities to get strong drinks, that suffer the malady in a higher proportion than other divisions of the service.

The table shows that of the 19,311 police under observation during twenty-four years, 663 had gout, or 3·4 per cent.; that 333 were treated for stomach, and 78 for liver diseases. In the same time and number of men, only three are recorded to have been treated for heart-disease, notwithstanding that there were 1420 cases of rheumatism, or a yearly average of 59·16. The disorders induced by exposure to vicissitudes of temperature and to wet—classed as catarrh—reach the highest number in the table, viz., 2255. The yearly average of these catarrhal disorders on the average force of 844·62 men, was 93·54 per cent., whilst that of phthisis (forty cases in the twenty-four years) reached only 1·66.

That the annual average of phthisis is so low we can only account for by the operation of the rule of the service—that if not on duty, the man is disqualified, and soon gets discharged from the force. We may, therefore, conclude that many impending cases of phthisis disappear from the registers before classification, by being returned as too weak, or as unfit for duty.

Within the same period there were eighty-nine examples of brain-disease, equal to a yearly average of 3·70; and of respiratory diseases 278, or one of 11·58.

Venereal complaints amounted to 341, or 14·02 on the yearly average. Respecting these, Dr. Brown remarks that the sufferers 'were punished until quite recently by stoppage of leave. This led to concealment, and often bad results. Now punishment is to be meted out for not presenting themselves when attacked.'

The hospital inmates have the advantage of a convalescent institution. 'After twenty-five years' service a policeman is of but little use, and a certain number are pensioned off every year; others, on the surgeon's certificate, are discharged as unfit for further service.'

Mr. Neison (*op. cit.* p. 415) gave an interesting outline of the vital statistics of the Metropolitan police for eight years—that is, from the establishment of the force in 1830 till 1838. Since those statistics (which were collected by a committee of the Statistical Society), the force has been greatly augmented, and also undergone numerous changes in internal organisation; whence those former numerical conclusions are rendered obsolete. It is, however, worth while to recall two or three facts then collected. One, that the relative mortality was less than that for the whole population of the country, by a little under one per cent.; 'but very much greater than that found to prevail in friendly societies.' Another outcome was, that the rate of sickness differed widely in the various divisions of the force, being higher among those stationed in denser-built and more populous districts. A third was, that the amount of mortality and sickness varied according to the seasons. Thus, in April, May, and June there was the smallest mortality; the second quarter in intensity was July, August, and September; the third, January, February, and March; and the highest, October, November, and December. The extent of sickness, however, did not coincide with that of mortality for the same months—June, July, and May had the least sickness; after them came September, October, and August; then March, February, and November; and last, with the highest ratio, April, December, and January. As a further result it appeared that the police could not continue in active service above three years.

Returning to the statistical facts recorded of the mortality of the Metropolitan police, it will be found that the percentage of mortality produced by phthisis was 33·7 per cent., whereas that of the postal service is 36·1. Diseases of the respiratory organs also exhibit a higher rate among postmen than with policemen. But this much has to be remembered, that the proportion of employed under the age of thirty, is greater in the case of postal than in that of police

officers, and that as liability to phthisis, and generally to respiratory diseases, is more pronounced in the earlier decades of adult life.

Section C.—*Post Office.*—I could get no information from the medical staff of the General Post Office on making application; for it appeared that they are not authorised to supply it. However, by the kindness of a friend, I am in possession of the reports of the 'United Kingdom Postal and Telegraph Service Benevolent Society,' which happily show the ages, employment, and causes of death of the members year by year. The returns of seven years indicate that the ordinary members of the two classes distinguished, taken with those who are in the 'Widowers' Branch,' amounted to 104,202, or a yearly average of 14·886. Within the same period the deaths numbered 903, being at the average rate of 8·6 per cent. annually.

From the enumerated causes of death, it appears that 326 of the 903 deaths were due to phthisis, which represents an average rate of death of 36·1 per cent. from that disease. Of the mortality from all causes, the ratio to the entire membership was 3·1 per 1000. The mortality from phthisis reached 74 per cent. of the whole number of deaths in the age-period from twenty to forty.

Next after phthisis in prevalence rank pulmonary diseases, including bronchitis, congestion and inflammation of lungs, and pleurisy. These are accountable for 152 deaths, or 16·8 of the entire mortality; apoplexy, paralysis, and diseases of the brain for 78, or 8·6 per cent.; heart maladies for 59, or 6·5 per cent.; and accidents and suicide together for 22, and renal diseases for 20 deaths respectively.

The general outcome of these figures for Post Office officials is, that their mortality from phthisis, calculated on the entire number of deaths, is greater than in the case of the police and custom-house officers. On the other hand, with regard to rheumatic, and especially gouty disease, the servants of the Post Office exhibit great immunity compared with the officers last named. But, again, their death from lesions of the nervous system are more numerous.

The employés comprised in the list analysed belong to

the several departments of Post Office work—consisting of telegraph and other clerks, of letter-carriers and postmen, of sorters and stampers, and some others attached to minor branches. As the number of each class of officers is not given, the relative prevalence of phthisis is not calculable. For at least one-half of the whole number, their duties may be pronounced sedentary.

SECTION D.—*Government Officials in General.*—Before closing this account of public servants, it will be well to note what Dr. Muirhead has to teach us respecting the diseases of the individuals he has brought together as a class, viz., 'Government Officials, Army and Navy, Indian Civil Service, Constabulary, Post Office, Inland Revenue, and Gaol Officials.' It is hardly necessary to repeat that the lives on which he has based his calculations are all assured lives, and therefore do not really afford data for conclusion respecting the whole number included under any of the designations included in the list. Under the head of Army and Navy, the assured will be represented only by a comparatively small number of officers. And, in like manner, as regards the other Government departments, an office of the position of the Scottish Widows' Fund will contain among its assured chiefly those of the official upper ranks, and only a sprinkling of those of the lower. Besides, excepting that they are employés of Government, those brought together under the heading have little else in common in vital conditions. But to proceed. Heart-disease occupies its customary place as the first in fatality; yet somewhat more than one per cent. below the average. Apoplexy, curiously enough, comes next with 11·470 per cent. compared with 9·119; whilst nervous diseases, the next in order, show an almost identical proportion between the ascertained figures and those representing the general average. Consumption occupies the fourth place with a lower percentage; but cancer, the fifth, exhibits a remarkable excess, being 7·885 to 4·977. Again, diseases of the liver, and those of the digestive organs, which follow in this order likewise, show an excess. Urinary diseases, as distinct from renal, do the same.

ORDER 6.—*Legal, Commercial, and Other Clerks.*—Under

the designation of clerks will be included certain occupied people who may object to be so placed; such, for instance, as secretaries, agents, and accountants, but all of whom are persons mainly employed at desks and in offices, and whose occupation is pre-eminently sedentary, and out-door exercise a more or less exceptional circumstance.

The work performed—reading and writing at a desk or table, almost always entails a stooping posture; the head advanced and back curved, the arms approximated to the chest, and the epigastrium often compressed against the table on which writing has to be done. This posture, as before remarked, is unfavourable to lung action and inflation, and to chest expansion; and, at the same time, interferes with abdominal movements contributory to the functions of the gastro-intestinal canal. The sedentary position and occupation favour inattention to the calls of nature, as well those from the bladder as the bowels.

In short, the business of clerks furnishes the best example of a sedentary occupation, of which the evils to health are so well known. Other circumstances about it are, that it invites the introduction of weak lives, and usually of young ones, in whom development is still proceeding, and who naturally need abundant fresh air, with freedom of movement for all the parts of the body, and particularly, opportunity for free lung activity.

It is, therefore, no matter of surprise that the health statistics of clerks are very unfavourable, and show a heavy mortality. As to the ratio of sickness, this appears small to what is met with in many occupations, owing to the nature of the employment permitting persistence at work; whereas, in occupations demanding vigour and activity, the onset of even small ailments puts a stop to labour. The following observations of Mr. Neison are much to the point. He writes (*op. cit.* p. 411):—

'Taking two occupations of recognised high mortality, tailors and clerks, they do not seem—particularly clerks—to be subject to so much as the average amount of sickness; and, on the consideration of the nature of these employments, it will immediately suggest itself that the same trivial circumstances which would be sufficient to disable sawyers, and also colliers and miners, would have little effect on

those following quiet occupations. Sawyers, colliers, and miners are subject to accidents and various injuries which cannot be considered constitutional disease or sickness; yet it entitles them to relief from benefit societies, and they will, of course, be returned on the sick-list. Tailors and clerks are less subject to those accidents, and accordingly their sickness is also less; the other classes, particularly colliers, being much above the average.'

The same writer (p. 59) has compiled a table to show the expectation of life among clerks, plumbers, painters, and glaziers, bakers, and miners respectively, between the ages of twenty and sixty, compared with that of the population at large, for a like age-period. The result is sufficiently striking; for it demonstrates that 'clerks stand lowest in the scale of the above employments; and that from twenty to sixty their expectation of life' is only 75 per cent. of the general average, whilst that of plumbers, painters, and glaziers is 81, miners 85, and bakers 88.

The more recent statistical investigations of Dr. W. Ogle (*op. cit.* p. 37), whilst confirming Mr. Neison's conclusion as to the serious mortality of clerks, affords evidence that the value of life among them is distinctly rising; a fact he attributes to the greater attention given in recent times to outdoor exercises and athletics, and to the engagement by employers of candidates of a higher class. At the same time, taking the normal comparative mortality of males at large to be 1000 between twenty-five and sixty-five, he calculated the mean mortality of commercial clerks to be 996, and that of law clerks 1151. The effects on health will be greatly varied by the accidental circumstances enumerated in the previous chapter on the conditions of labour. In fact, the accidental may, in this vocation of clerk, outweigh in energy for evil, all that can be attributed to sedentary work itself; as, for example, confined, ill-ventilated offices, prolonged hours of labour, personal qualities predisposing to disease, and ill-regulated lives.

Besides those causes of recent improvement in their health-status adverted to by Dr. Ogle, undoubtedly others have been in operation in a like direction for several years past; to wit, shorter office hours, better pay, and by its help better food and lodging, and a generally improved office-accom-

modation, now so extensively observable in the spacious buildings constructed for chambers and offices at the present day.

We are fortunate to be able again to call to our service the returns of Dr. Muirhead, as his Class VI., comprising clerks, book-keepers and cashiers, resembles the order of employed persons now under notice. The first disease in the list of comparative fatality is, what other statistics have taught us to expect—consumption. In place of the average per cent. of 9·519, there is a percentage of 20·935. Diseases of the nervous system are next in order, with a fractionally lower percentage than the average; then follow cardiac maladies, with an average of 10·245 in place of 12·879, and after them, pneumonia, with an excess represented by 9·131 instead of 6·848. The next following is apoplexy, with 5·791 as compared with 9·119. Other diseases showing slight excess are cancer and renal affections, whilst the bronchitis average mortality is considerably below the general standard. The same holds good of hepatic maladies, and of diseases of the urinary system other than those of the kidneys themselves. Old age has fallen to the position of sixteenth among the assigned causes of death, the lowest noted in the whole series of classes; holding even a worse one than in the mixed group of tradesmen collected in the class of Hazardous and Unhealthy occupations, where it occupies the thirteenth place, or in the Miscellaneous collection of Mechanics constituting the thirteenth class. Such are the results, notwithstanding that the lives dealt with had been accepted as assurable by the Scottish Widows Office.

Order 7. — *Commercial Agents and Travellers* are a very miscellaneous body of men, and the circumstances belonging to their employment are almost as varied as are the trades and callings in which they are interested, both with regard to social position, remuneration, and the nature of the articles dealt in. Since Dickens so admirably depicted the habits and failings of commercial travellers, or bagmen, so-called of old, an immense change has overtaken their former ways and doings, chiefly by the substitution of railway for coach travelling, and by the great alterations in hotel accommodation and management. The business part of

their character has developed largely at the expense of the social and convivial, and the exigencies of modern trade have curtailed opportunities for rest and 'refreshment.' The 'commercial room' at inns is now a quiet parlour, and the rules and customs formerly enforced have died out, greatly to the advantage of its frequenters in the matter of temperance and health. In fact, agents and travellers of the present day seem mostly to be a serious class of men, working under pressure to save time, to evade competition, and drive bargains. In many trades dealing with dry goods they are charged with heavy and bulky luggage, conveying samples for inspection, the care and safety of which is an anxiety superadded to that of securing orders, pleasing customers, and avoiding transactions that may prove unsound.

On the whole, therefore, the occupation of commercial travellers is one calculated to tax in no small degree both mental and bodily powers.

But the list of conditions unfavourable to health must be extended by noting the loss of rest frequently imposed on them by night travelling, the risk of damp beds—(a really common event, followed by rheumatism or visceral inflammation of some sort)—irregular meal hours, a still lingering custom of treating and the taking of stimulants when needful food is not at hand. Travellers for brewers and wine and spirit merchants fall victims, in a very high proportion, to alcoholism and its consequences. Drink is practically forced upon them by the usages of the trade and the desire to please their clients. In my own experience the lives of these business men is very short, and sickness comes on early in their career; nevertheless, it is not so much the consumption of a too copious draught of liquor at long intervals, as it is the repeated taking of small doses throughout the day, and ending at night with one or several glasses of spirit and water, that works mischief. In short, their habits, their sickness and their mortality, stand nearly on a level with those of publicans.

Again, among *Commercial and Commission Agents*, there is a wide disparity of health-conditions. On the one hand there are the well-paid agents of insurance establishments,

and those of publishing and chemical firms and other large establishments; and, on the other, there is a host of men acting as agents for minor trades and for industrial assurance offices. When the former have to travel they can command every comfort and convenience, and take their place socially with the general residents in hotels, whilst their work does not involve the personal anxiety and responsibility incurred by the ordinary commercial traveller. The commission agents of the second order are mostly taken from the more intelligent among the working classes, and their duties are almost continuous, and attended by frequent annoyances. On the other hand, they, for the most part, have little travelling to do beyond their immediate locality. In the instance of many of the higher class of agents, their duties assimilate them to certain grades of clerks; office attendance and correspondence being a leading part of their work.

Such are the general hygienic features of the class under consideration; but it is evident that the sickness and mortality experience will differ in no small degree between one description of commercial agents and travellers, and others. No statistics are to be had to illustrate this fact, and we can do no better than quote what Dr. Ogle has to say of commercial travellers at large. According to his table of comparative mortality, they present a mortality figure of 948; one, therefore, rather below the standard of 1000. But in respect to diseases prevalent, nervous maladies, suicide, consumption, urinary and liver diseases, alcoholism and gout exceed the standard rate. The widest divergence is displayed in the case of suicide, of nervous and liver diseases, and of alcoholism and gout.

In the list of occupations arranged to show the frequency of certain diseases, commercial travellers, in the matter of suicide, stand next below costermongers, who are first in the scale; in that of alcoholism and gout, the fifth; in that of liver affections, the fourth; and of nervous maladies, the eleventh. The last were accountable for 14·6 per cent. of the mortality, and respiratory diseases produced nearly one-sixth of it.

These facts point to alcohol as a primary cause. The high ratio of phthisical mortality—168 deaths out of 663—

is, in Dr. Ogle's opinion, in some degree attributable to the same agent.

We must not lose sight of the circumstance that the foregoing statistics are based upon the census of 1881, and it is very supposable that, during the succeeding decenniad, a very great amendment has proceeded, and that the next public returns will, on analysis, display a vast improvement in the health aspects of the calling. But to render it what it should be, the absurd custom of adjourning to hotels and drinking over business transactions must be abandoned.

ORDER 8.—*School Teachers.*—A large proportion of those occupied in the business of teaching are subjected to health conditions bearing a general resemblance to those of clerks and secretaries—that is, they lead an indoor and more or less sedentary existence, and are breathing air vitiated by artificial lights, and still more, by the breath and cutaneous exhalations of the pupils around them. But their duties involve considerable mental strain, and many annoyances inseparable from teaching and disciplining the young; and, in the case of Board School teachers, continual anxiety respecting the results to be assessed by inspectors, upon which their remuneration and their credit largely depend. Dr. Ogle's comparative mortality figure for these workers is 719, which contrasts very favourably with that for medical men—viz., 1122; and that for law and commercial clerks, taken together, 1073.

It must not, indeed, be lost sight of, that all Dr. Ogle's comparative statistics apply only to males. My own impression is, that the death-rate of the teaching profession would appear less favourable if female teachers were taken into account. I also believe that the mortality, chiefly from phthisis, is considerable among teachers in the process of training—*i.e.* in the undeveloped stage of pupil-teachers.

Nevertheless, Dr. Ogle's remark is very true, that teachers in public elementary schools represent a selected body of individuals, of a higher type of constitutional vigour than in other avocations, in consequence of regulations demanding evidence of freedom from disease prior to their admission to

training colleges. Another observation he makes is, that the death-rates of teachers have, of recent years, greatly declined. This occurrence, he surmises, may be due to 'the improved status which the profession has been gradually acquiring.' But a still more powerful one may be recognised in the vast improvements that have proceeded during the last twenty years in school architecture, in sanitary arrangements, and in the cubic capacity of air insisted upon. Nor must we forget that the conditions of a schoolmaster's employment are materially amended by longer holidays and better remuneration than formerly, and that the struggling 'adventure schools' of bygone years have been well-nigh swept away—both schools and schoolmasters alike.

Mr. Ratcliffe grouped clerks and schoolmasters together in his statistical analysis (*op. cit.* p. 45). His general conclusion for the two was, that they 'experience a less aggregate sickness, and a less general expectation than any class of lives given in this experience,' that, namely, of Friendly Societies. That the numbers obtaining relief from their clubs on account of sickness should be below the aggregate for all occupations is explicable by the circumstance noted in the case of other callings requiring only moderate physical capacity, viz., that teachers can prosecute their employment under conditions of ill-health which would at once throw out of work those engaged in strong bodily toil. Moreover, few school teachers join benefit societies, and consequently the sickness returns of clubs can give little insight respecting their vital statistics. In a less degree, perhaps, this same fact holds good concerning clerks.

So far as my experience goes, the business of school teaching is not conducive to health and longevity. This observation applies with greater force to teachers in elementary schools, whose energies are kept on full stretch to satisfy managers and inspectors, and to accomplish results whereon their income in some measure depends. Their work likewise has the defect of want of variety. They have to drill their young pupils, including a good proportion of blockheads, as they in successive generations come under their sway, in elementary work, of constantly recurring sameness; they never attain a point at which their work can

afford them real interest. Rules and lessons lapse into well-worn routine, and instead of awakening interest deaden it, and reduce the teacher to an educational machine—a wheel rotating on its axis and never advancing.

An occupation bearing such characters is not favourable to the mind. Its relations to the body are little better. As before noticed, it is one involving much indoor confinement and standing, some measure of unhealthy sanitary conditions, and a continuous strain upon the attention, and on the voice in giving lessons and keeping order.

Dr. Ogle's statistics do not place the employment in an unfavourable position as regards its healthfulness; and with respect to those who have arrived at adult age, it would appear that their ratio of sickness and death is not above the standard. My impression, however, is that many succumb in the pupil stage of their calling, particularly females; for numerous cases of young women, and of young men too, breaking down under the requirements of college and school life,—not a few of them falling into consumption, have come under my notice; and it is my practice to recommend parents not to place their children in the scholastic profession if any personal or family weakness of constitution exists.

In connection with the topic before us, Dr. Hertel's excellent book on *Over-pressure in High Schools in Denmark* deserves perusal. His researches, however, being carried out almost exclusively with respect to scholars only in High Schools, their results cannot be applied with sufficient confidence in this place. What he demonstrated were the grievous consequences to health, particularly to growing youths of both sexes, of prolonged study, with insufficient rest and sleep, and almost unvaried by employments and diversions calculated to exercise and develop the bodily organs and functions.

Too much of what he exposes in Danish educational establishments is, I fear, to be met with in English training colleges, where ambition, emulation, and competition are fostered by the baits of immediate prizes and of subsequent advancement in life. We need an inquirer in this country like Dr. Hertel to discover how many lives break down in the process of making school teachers, and how many when

made are fitted mentally, morally, and physically for the efficient and profitable performance of the duties that devolve upon them, for a great deal more is needed to make a successful teacher than a head crammed with common-place information on any number of subjects of instruction.

The subject of the health conditions, diseases, and mortality of school teachers in this country demands a longer discussion and investigation than it can receive in this place. The statistics of mortality, of the ratio of disease, and of the particular diseases predominating in this group of the employed require to be gathered from the special records of the profession. These particulars need to be ascertained separately for males and females, for certificated teachers and for pupils at college. We want more precise knowledge of the effects of pressure in study upon the physical powers and upon development, and of close application of the eyes upon eyesight. Many pamphlets have been issued debating one or more of these subjects, but their value is lost, as their facts and statements have not been collated.

By the kindness of the Secretary of the Teachers' Provident Society, the returns of those who have received sick pay during 1890—sixty-six males and thirty-one females—have been supplied me. The number is too small to furnish reliable inferences as to the prevalent diseases of teachers. What can be made out amounts to this, that the epidemic of influenza in the year named was the cause of sickness in twenty-eight individuals, or in 28·8 per cent.; that ten cases of rheumatism happened, of which eight were among the males; that throat affections were numerous in the form of tonsillitis and laryngitis, numbering together sixteen cases; and that inflammatory affections of the respiratory organs happened in nine. But phthisis does not appear in the list, possibly owing to some rule of the society. Still, very possibly certain of the reported cases of laryngitis were tubercular.

ORDER 9.—*Fishermen and Bargemen, Watermen and others occupied about the Seaside and Rivers.*—These con-

stitute a miscellaneous class of occupied people, and among them are many whose employment is unique in respect of external hygienic conditions, and in mode of life. Yet it has not occurred to any members of the medical profession to study their health aspects, their prevalent diseases, and their longevity and mortality. The impression to be formed on consideration of their surroundings is, that their occupation is favourable to health, though having as a drawback a liability to accidents, chiefly by drowning. Its character as an occupation on the water assimilates to that of custom-house officers. Nevertheless, it must be remembered that the latter enjoy advantages not possessed by the ordinary fisherman, barge and boat men, in the matter of regular pay, of gratuitous medical aid, and of various sanitary arrangements.

The chief health conditions of coasting sailors and river-side workers are, exposure to weather, to heat, cold, and wet, to vicissitudes of temperature in passing to and from heated cabins, to insanitary sleeping-berths, to laborious and dangerous duties, to strong emotions and anxieties from the perils of the deep, to the evils of a more or less unsettled existence, and to temptations to intemperance, and at times deficient or unwholesome food. To these must be added, on the favourable side, the breathing of sea air, rich in ozone, the exhilaration and sense of freedom felt in sailing over boundless space.

a. Fishermen.—In the comparative mortality table of Dr. Ogle, fishermen appear to suffer a higher mortality from heart affections than other classes of working men. This may possibly be traced to the very heavy physical strain their work so often entails, and, in some degree, to the prevalence of rheumatism from exposure to wet and cold. Unfortunately, the operation of this latter disease-factor cannot be estimated, as it does not appear in the list of diseases noted. With regard to most other maladies, including phthisis and respiratory and urinary affections, those men have a lower mortality than the average. In the case of liver and stomach diseases, the figures are not quite so favourable; but in that of alcoholism their position is very

good, as mortality attributed to it is not quite half of the calculated average for all occupations; and gout is not represented at all. But, as might be looked for, accidents are in excess, figuring for 152, in place of the average of 67.

The conclusion from these statistical data is, that fishermen are a very healthy body of men, and would head the list of occupations arranged according to their healthiness, were it not for the high ratio of diseases of the circulating system and of accidents. As things stand, their mean annual death-rate per 1000 living is the same as that calculated for 'males in selected healthy districts' (*op. cit.*, p. 25); whilst their comparative mortality figure is 797, in lieu of 804 for the latter-named group, and of 1000 as estimated for all males in the country.

β. *Bargemen, Lightermen, and Watermen* are to a great extent workers on rivers and canals, and have, on the whole, heavier labour than fishermen, whilst they do not possess the advantages of free ocean life. They are also greatly more in contact with town life and the lower strata of society; and they themselves belong commonly to a lower grade than do fishermen, who, for the most part, take to their occupation as a hereditary one, requiring special training and knowledge, and having an acknowledged status.

These riverside workers are likewise a less settled race than fishermen; many are without fixed homes on shore,—a fact especially true of canal boatmen. Their life is more entirely spent on board their vessels, all the insanitary evils of which they are, with slight interruptions, constantly exposed to. And, speaking of them as a body, their reputation is that of intemperate men of very ill-regulated lives.

Taking all the above circumstances into account, we are prepared to find that their vital statistics are much more unfavourable than those of fishermen; and, indeed, in a higher degree than we should have reckoned upon. In illustration: Their comparative mortality figure is 1305, as compared with 797, whilst their mean annual death-rate is but slightly less than double.

Dr. Cameron (*Manual of Hygiene*, p. 246) has had special

opportunities for observing the sanitary state of bargemen. He alludes to their occupation as destructive of health. This is due primarily to the wretched sleeping accommodation provided in barges, and to overcrowding and neglect of cleanliness. He quoted examples of barges and their inmates examined by himself, and lays down certain rules for amending their condition, the chief of which are that a minimum of 220 cubic feet be given to each occupant of a sleeping cabin, and that proper ventilation be secured.

(γ) *Boatmen serving on board river steamships.*—The only essay I have met with respecting the hygienic state and the diseases incident to men employed on river boats is one on 'River exposure and its effect upon the lungs,' contained in the Annual Report of the Supervising Surgeon-General of the Marine Hospital Service of the United States for the fiscal years 1876 and 1877. The essay in question is by Walter Wyman, a surgeon in that service. It refers to the conditions of employment on board steamers plying upon the great American rivers of the west, and as those conditions differ very widely from what prevail in this country, the facts recorded have but limited application to British sailors in our fresh waters. It is enough to say that exposure to vicissitudes of temperature on board the boats, harshness of treatment and laborious toil, prevail more intensely than in our own country. The 'hands' most exposed are the firemen and the 'rousters,' or unclassed men, for the most part negroes, who do all the rough work of the steamers. These men, Mr. Wyman states, suffer severely with acute respiratory diseases, and with chronic pneumonias, or 'Viemeyer's phthisis.' And, notwithstanding that the firemen, as a class, are a picked set of men, naturally robust and of strong constitution, Mr. Wyman found that 'out of forty firemen taken at random, with no effort to select the unhealthy ones, only ten were found who had not contracted pneumonia or pleurisy, or who had not been afflicted with hæmoptysis during the period in which they had pursued their avocation.' And of these thirty 'quite a number complained of existing respiratory trouble,' and several had repeated attacks of pleurisy and pneumonia.

The writer attributes this sad state of things to the pre-

vailing folly of the men in emerging, without any precautions, from the hot furnace-hold to the deck to cool themselves; to the chilling of the body while at work by strong draughts, especially when removing the clinkers from the furnaces, and to the excessive and prostrating heat they undergo in cleaning out the boilers, which they too commonly enter while still highly heated. This is so recklessly done 'that many a fireman has been taken from the boiler in an insensible condition, and laid upon the deck to revive,' a proceeding necessarily attended by sudden chilling, and the almost certain lighting up of disease.

ORDER 10.—*Laundresses* constitute a class of female workers with distinct hygienic surroundings. The prominent conditions of labour are exposure to heat and steam, long immersion of the hands and forearms in very hot, soapy, and alkaline water, prolonged standing, and considerable labour alling chiefly upon the trunk and upper extremities.

There are two departments in their occupation, viz.,—washing and ironing. The former is the more laborious, and subjects the women to a dense steam, to accidents from boiling water, to the irritation of the skin of the arms and hands by soap and by alkaline water, particularly in rubbing the articles in wash, to wetting of their clothes and feet, to continuous standing, and to a leaning position over the washing trough or tub, with accompanying inhalation of steam, often more or less disagreeable. When washing the clothes of the sick they are also exposed to contagion, are liable to erysipelas following abrasions and scratches of the integument, and to onychia and festering sores of the fingers. Further, the action of the soap and alkali is provocative of troublesome eczema on the hands and forearms, whilst the long standing leads to varicose veins and ulcers.

Washerwomen, again, are very subject to chronic rheumatism, and to rheumatoid arthritis of the hands, and they breathe a heated atmosphere loaded with watery vapour, which predisposes them to attacks of bronchitis. This predisposition is rendered active by their frequent passage from the hot steaming rooms of the laundry to an outside drying ground. In many larger establishments and in public

laundries the drying is done in heated chambers upon sliding frames,—'horses.' By this proceeding the frequent transition from the laundry to the outer air is avoided, but, on its part, it adds materially to the heat of the working place.

The hands become sodden by immersion in soapy hot water, to which, occasionally, chloride of lime is added. But it is singular how soon the softened and swollen hands recover themselves when work is given over. Nevertheless, the labour expands the hands and blunts their shape, and when a mechanical hurt happens to them in the softened state the wound is difficult to heal, and often suppurates. When the employment is long pursued the joints of the fingers and the wrists get thickened, deformed, and stiffened by the act of wringing the clothes.

The business has of late years been shorn of many of its evils, and at the same time had its labour lessened by the introduction of machines for wringing, rinsing, and washing. Moreover, it is assuming more and more the character of factory work and of associated labour, and to meet this altered state of things special buildings have been erected, securing ventilation and generally improved sanitary arrangements.

The finishing branch of the laundress's occupation, mangling and ironing, is less laborious than that of washing, but the heat attending it is greater, though charged with much less steam. The heat proceeds from the ironing stove and the irons. In large establishments, as in Belfast, where linen is finished, the ironing stove is dispensed with by the construction of a detached oven for heating the irons. Another plan is the use of hollow irons within which a jet of gas is burnt, carried thereto by flexible tubes. But this has its drawback owing to the tendency of gas to escape, and to the diffusion in the atmosphere of the unhealthy products of gas-combustion.

Like washerwomen, the ironers suffer from continuous standing, and from much fatigue of the arms by the weight of the irons and the exertion of using them. Moreover, in both the divisions of the laundry business the women will often work very slightly clad on account of the heat, and thereby increase the liability to taking cold.

Other ailments of laundresses, besides those already named, are anæmia, uterine and catamenial disorders, attributable to working in a heated atmosphere and to long standing; the last-named condition provoking swelling and soreness of the feet and legs, besides varicose veins and ulcers.

A startling statement recently appeared in the *Queen* newspaper, June 27, 1891, from a special correspondent who made particular inquiries as to the health of laundresses, in relation to the debated proposal to place laundries under the Factory Act. By the courtesy of the house-physician of the Brompton Consumption Hospital, he tells us he was able to search the records of admissions, occupations, and diseases for a period of two and a half years. This investigation showed that 2½ per cent. of females admitted in that hospital are laundresses by occupation. This, as remarked, is a very large percentage, seeing that patients are brought to that hospital from all parts of England as well as from the immediate neighbourhood.

Of the laundresses admitted, almost all suffered from pulmonary consumption, the few who did not having bronchitis or heart-disease.

Dr. Givre, in his essay on Tuberculosis among Silk Workers in Lyons, calculates that laundresses in that city suffer equally from that disease with silk hands.

Reviewing the conditions of labour of laundresses as a whole, they must be pronounced unfavourable to health, particularly where laundries are ill-ventilated, and exposure to changes of temperature incurred. The occupation is likewise most unfit for those predisposed to phthisis or chest diseases, and for the weak and anæmic.

It is right to note that the more potent influences at work are really accidental, arising from ill-built and ventilated work-places, from the pursuit of the occupation in towns amid unfavourable surroundings, and from the class of women usually engaged in it,—their habits, manners, and customs. For if we inquire into the health of laundresses employed in private families, it is exceptional to find examples of broken-down women such as are seen in the laundries of large towns.

ORDER 11.—*The Domestic and Serving Classes* constitute a very extensive group of working people, having most diversified health conditions. No general statements can be made as applicable to all. The differences in position as regards health, of the upper servants, male and female, in wealthy establishments, and that of the poor general servants—mostly females—of small tradesmen or lodging-house keepers, are so great that the two classes are not comparable.

Moreover, there is nothing of a special nature characterising the work done by domestic servants to affect health; the agencies in operation belong all to the accidental class, and vary in almost every household. What work falls to them, although infinitely varied, is sufficiently well known to make a description unnecessary.

Indoor servants in the houses of the wealthier classes of society, and more especially those of them of the male sex and upper servants, usually live under conditions calculated to induce plethora, by reason of want of sufficient outdoor active exercise, and, at the same time, of the presence of abundance of nutritious food, and probably also of stimulating drinks. In this section of the serving community we therefore naturally look for derangements of the digestive organs, hepatic diseases, gout, and nervous maladies.

The indoor male and female servants of the professional, and of the upper middle-classes, there is reason to believe, live generally under conditions favourable to health, except it be in the matter of want of outdoor exercise. But when we turn to the female domestics in households of the lower middle-class, in lodging-houses and the like, we encounter a multitude of circumstances fraught with harm to their bodily well-being; to wit,—over-toil for long hours, confined and insanitary sleeping accommodation, indifferent and even insufficient food, and excessive pressure by worry and overtaxation of bodily and mental powers; and all these ills to the flesh and spirit in unbroken action, save at rare intervals, by rest and diversion.

I believe that the experience of medical men generally will bear out my conviction that domestic servants suffer a high rate of sickness. It is also by no means uncommon to observe that infectious and contagious diseases and fever

find access to families by medium of indoor servants. And my knowledge of asylum statistics inclines me to believe that domestics contribute a large contingent to public asylums.

This last fact may be ascribed partly to the over-strain many of them suffer, their daily vexations, and the want of sympathy shown by employers, and partly to psychological influences. Such influences are conceivable in the usual very imperfect education and want of mental discipline; in the almost uninterrupted pressure upon their energies by anxious duties and samely occupation, and in the enforced suppression, more or less, of their natural feelings in the absence of congenial society. Oppression of action, and suppression of feeling, imply a rebound when they cease; or, when too long continued, a lapse into lethargy of mind and body, or into absolute dementia. The emotional part of female nature is hard to be destroyed, and the love of dress never; hence the poorest maid-servant, when she can escape her drudgery, will expend her emotions in a love affair, and her feelings for beauty in finery of dress.

Admitting the general correctness of this representation of the material and moral condition of the female serving classes, I think that it affords some explanation of the fact that insanity occurs in high ratio among them. The mind undisciplined in its higher faculties is over-matched by the emotional powers, which, if subdued by the circumstances of servitude, will break out in excess when pressure is removed, and expend themselves upon objects disappointing and often painful. Moreover, the co-operation of the same set of influences may be referred to in explanation of the well-ascertained fact that this class of females contributes in the highest proportion to the ranks of fallen women, and thus, again, indirectly augments the prevalence of mental disorder.

The last Report of the Royal Edinburgh Asylum, which has just reached me from the distinguished superintendent of that institution, Dr. Clouston, is confirmatory of the opinion that domestic servants contribute a heavy contingent to the ranks of the insane. Thus, of 177 females admitted in 1890, as many as twenty-eight were domestic servants, and in number were only surpassed by housewives, who were sixty-four. The large preponderance of the latter in the

female population of a city sufficiently explains the excess of their admissions. Ladies counted fourteen, but of all other occupations in the list, none appear to have furnished but two or three instances of lunacy; the highest among them being dressmakers, who contributed six, and factory-workers five. The percentage of servants to the whole number of admissions equalled 15·8; that is not far less than one-sixth.

One almost special lesion afflicts housemaids and others who kneel much at their work, viz., the swelling of the *bursa patellæ,* with more or less inflammation. And if we look to notes of cases of illness among common servants, we find that the most frequent are—anæmia, headache, dyspepsia, and chronic gastritis, often complicated with gastric ulcer; acute and chronic rheumatism; facial neuralgia; swollen ankles and varicose veins, and menstrual derangements, with frequent leucorrhæa. A large proportion of these ailments are due to overwork, and poor and improper diet. Referring to notes of forty-two cases treated as outdoor infirmary patients, I find 23·8 per cent. were assigned to dyspepsia; 19 per cent. to uterine disorders; 21·4 to anæmia, debility and overwork; 14·2 to hysteria and epilepsy, and 11·9 to phthisis. Other diseases were represented by units.

With regard to the vital statistics of indoor domestic servants we unfortunately have not the benefit of Dr. Ogle's reseaches, although favoured by those jointly appertaining to 'grooms and domestic coachmen.' We have, however, some information respecting the former from both Mr. Ratcliffe and Mr. Harden, based on the experience of benefit and industrial assurance societies.

From Mr. Ratcliffe's figures, domestic servants show the highest range of mortality between the ages of thirty-five and forty-five, and that, compared with other working people, they have a greater immunity from sickness and superior expectation of life at every decenniad. Mr. Harden, on his part, satisfied himself that they had the smallest ratio of deaths from phthisis, and in this respect occupied the opposite end of the scale to that held by factory operatives. On the contrary, in regard to deaths of females from diathetic diseases, he found domestic servants contributed the highest, and seamstresses and factory operatives the lowest.

Coming now to the two descriptions of servants, Dr. Ogle places under the headings of grooms and domestic coachmen, and of inn and hotel servants, we find that the former section stands well in its health aspects; that its comparative mortality figure is 887; its mean annual death-rate between twenty-five and forty-five, 8·53; and between forty-five and sixty-five, 23·28. The last fact seems to show that, when middle age is reached, a heavier relative mortality is the rule.

Inn and Hotel Servants.—But when we turn to the statistics of male servants employed in inns and hotels, a far different result displays itself. The corresponding mean annual death-rates rise to 22·63 and 55·30, and the comparative mortality figure to 2205; the highest that occurs among all the trades included in the table, exceeding even that of that miscellaneous body, the London labourers, which is represented by 2020.

This mortality of male servants in inns and hotels is so excessive that it is hard fully to realise its causes, though several potent ones at once suggest themselves. In the first place, their hours of toil are very excessive, the time allotted for sleep very short, their work is mainly indoor and very exhausting, owing to constant standing, and active movements, in never-ceasing alternations; their sleeping apartments are often wretched, frequently in the basement, and devoid of ventilation, if not of daylight; and lastly, and above all, there are the ever-surrounding temptations to indulge in alcoholic drink. These conditions go far to account for the fact before us. As supplementary thereto may be added, that in the whole body of male domestics in inns and hotels, there will be a considerable proportion of individuals of inferior vitality who entered on the employment as apparently one of no heavy labour. Further, the circumstances of the majority being unmarried men, in the prime of life, and living under conditions rather provocative of the animal passions, is a probable incentive to sexual indulgence and immoral life. A third common accessory incident obtains in irregular meals, in food and drink,—often of rich and stimulating character, taken at odd times, provocative of hepatic and digestive disorders.

Females employed in hotels and restaurants are, for the most part, greatly overworked, though not underfed. In the case of waitresses at the bars of inns and refreshment-rooms, the most prominent evils are, prolonged standing for long hours, and few opportunities for outdoor exercise by day. These obvious conditions of toil produce weariness, if not deformities, of the spine, pelvis, and feet, swelling of the ankles and feet, and varicose veins, irregular and painful menstruation, gastro-intestinal derangements, and anæmia.

It is gratifying to learn that some large employers of waitresses, among whom Messrs. Spiers and Pond deserve mention, have framed regulations allowing two hours' rest from duty in the course of the fourteen hours for which their services are required. But even twelve hours is an excessive period of time for almost continuous standing, and considerable expenditure of attention and vital energy.

Persons of both sexes employed in the service of hotels and restaurants, do not occupy an equal social position with domestics in good families. For it happens that in the selection of servants by householders, a previous engagement in such establishments operates very disadvantageously, and frequently excludes them from private service. The supposed licence in conduct permissible in hotel life, is deemed an unfit preparation for the proprieties of private domestic life. This small circumstance may exert some effect for the worse on the vital statistics of hotel servants, by causing a gravitation of inferior lives to those places of public entertainment.

ORDER 12.—*Individuals Concerned in the Transport of Persons and Goods.*—These, by their number and the peculiar incidental conditions attaching to their calling, demand a place in a list of occupations of a non-manufacturing kind. However, the information as yet collected respecting them is very scant, and as regards many of the sections into which they are divisible, very difficult of attainment.

a. Railway Employés, Engine-Drivers, Stokers, Guards, and Porters.—What is best known about them is their terrible liability to accidents; a matter yearly reported upon in considerable detail in the Annual Parliamentary returns of the Railway Commissioners.

Dr. Atkinson, of the Crewe works, where above 7000 men are employed, very kindly gave me an outline of his experience among them. On the subject of the locomotive hands, he writes:—

'I have often noticed that young men who have been employed in the sheds, cleaning engines with soda and potash, become thin, anæmic, and decidedly sickly in appearance, but if transferred to locomotive work as firemen or engine-men on the line, they regain their flesh and healthy aspect. Our engine-men become decidedly corpulent. They are usually long-lived, but are subject to winter bronchitis, and their common complaints are indigestion, varicocele, and varicose veins. Among the 4000 employed, not more than six deaths occur in a year from phthisis, and rheumatic fever is of rare occurrence.'

The circumstance that locomotive engine-drivers get fat in the course of employment, is insisted upon by Dr. G. W. Furey, in a short paper written by him in the *Philadelphia Medical Bulletin* for July 1889 (p. 212). The examination and weighing of nineteen of these men indicated that each had gained, in an average period of eleven and a half years, thirty-one pounds. Curiously enough, their companion workers, the firemen, whose conditions of labour are closely similar, exhibited no such growth; but rather a tendency to the reverse state of things. The explanation of the phenomenon is by no means clear. My own limited observation of locomotive drivers favours the conclusion that they are disposed to obesity; and all that I can suggest to explain the contrast existing between them and their firemen is, that their better pay enables them to get better food and more of it; that they escape the laborious and hot work that falls to the lot of the firemen, and, at the same time, get little active exercise for the whole body.

Certain writers have advanced very positive statements regarding the ills, both to body and mind, belonging to this calling, and the popular idea is that engine-drivers suffer sadly from nervous disorders, and in a comparatively few years break down, and become incapacitated for the employment. Dr. Atkinson's experience does not sanction these notions, which probably have had birth from narrations of individual

cases—a basis for conclusions that is most untrustworthy, though popular. However, this point, and many others connected with the railway employment in general, deserve special investigation at the hands of railway surgeons.

b. *Drivers of Public Vehicles—Cab, Omnibus, and Tram-car Men, Carriers, and Carters* form a class of occupied people having as a common character the carriage of persons and goods with more or less exposure to weather. But the differences in health conditions out-number the points of similarity; for the former are almost as many as are the individuals occupied in the business. In great cities like London, the drivers of omnibuses and cabs form a large fraternity, subjected to special police regulations, held together by the bonds of a common employment, and by voluntary associations. They suffer from long and often late hours, from exposure to the inclemencies of weather, and to many hardships and annoyances. They are recruited from the list of private coachmen and grooms, and to no small extent from the prodigals and the good-for-nothing born to superior positions. Among them, as a body, intemperance prevails widely, along with its frequent accompaniment, dissolute living. Their abodes are frequently unhealthy, not uncommonly situated in confined and ill-ventilated yards, and placed above the stables. In short, they are surrounded by a host of insanitary conditions, and, as a result, suffer the consequences of such; furthermore, they have more than their share of accidents.

If we bear in mind the circumstances of their employment, and the origin of a large proportion from broken-down members of society, it will be no surprise to learn that their comparative mortality figure is 1482; a number surpassed only by five other occupations occurring in the whole list.

The causes of death do but point to the same conditions. Thus we find that phthisis is as 359 to 220 in other occupations; nervous diseases, 134 to 119; diseases of circulation, 160 to 120; respiratory maladies, 341 to 182; urinary, 65 to 41; hepatic, 54 to 39; alcoholism, 33 to 10; gout, 11 to 3; and accidents, 84 to 67. Moreover, a comparative table of industries with highest mortalities, shows that they are second

only to innkeepers as sufferers from alcoholic excess and gout, that they hold the fourth position as regards diseases of the circulatory system, and the fifth in reference to hepatic and urinary maladies.

Carters, Carriers, and Haulers also constitute a group of occupations whose mortality ratio is less unsatisfactory than the one last noticed, though still very high. Probably brewers' and distillers' draymen are registered as carriers, and if this be the case, we have a partial explanation why this class stands so indifferently in tables of vital statistics. For in the case of country carriers and carters, though seldom total abstainers, we have an assemblage of men whose labour is out-of-doors, and for the most part unattended by any marked unhealthy features, and whose life-value observation leads me to conclude to be equal to the average. Doubtless the carriers and carters of London live under far worse hygienic circumstances, and suffer greater temptations to intemperance and irregular living, than their rural colleagues. But accepting the returns as presented to us, we find the mortality figure of the class, as a whole, to be 1275, and the mean death-rate per thousand living, 12·52 for the first twenty years of life ending at forty-five, and for the second twenty, ending at sixty-five, 33·00.

It unfortunately happens that an analysis of diseases producing the mortality has not been presented by Dr. Ogle for this section; but we may assume that their maladies will resemble generally those of cabmen, although in a lower ratio of prevalence.

ORDER 13.—*Labourers* form a very extensive class of the population, but have no common characteristic, except that of being engaged in manual toil, and this, too, of the most varied kind. They constitute, in fact, a working class of no definite kind, and therefore exhibit no common health conditions. For it is clear that these last will differ according to the particular trade or manufacture to which, as accessory agents, the labourers are attached, but of the technical processes of which they are supposably ignorant.

They represent a section of the community born to toil,

with small chance of rising to the position, or of getting the rewards allotted to the recognised artisan. Still, among them are a certain number of discharged artisans, and of people whose trade has decayed and left them unemployed, and a smaller proportion of men whom a careless extravagant career has brought down to the inferior level they occupy.

On examining the health aspects of the occupation, it is at once perceived that it includes two orders,—*rural* and *town* labourers. The former hold a more definite position in the labour scale than the latter, and, as agricultural hands, enjoy superior sanitary surroundings. Vital statistics bear evidence to the last fact. Still, Mr. Neison cautions us against attributing the higher value of life among agricultural contrasted with town labourers solely to the influence of locality, inasmuch as employment produces as wide a distinction as locality (*op. cit.*, p. 53). To elucidate his views, Mr. Neison subjoins several elaborate tables, supplemented by a brief one to exhibit the fact 'that the expectation of life among labourers in the rural districts exceeds the expectation of the rural districts generally throughout the whole term of life. On dividing the whole period from twenty to seventy years of age into decenniads, the difference per cent. in favour of rural labourers is found to rise progressively from 5·6251 to 7·8146 when the sixtieth year is reached, after which it drops in the following ten years to 4·0072.'

And he comes to this conclusion, 'that even in the same locality, in the rural districts of the country, where all the supposed contaminating influences of ill-ventilated houses, narrow streets, bad sewerage, poisoned air, epidemic town fevers, and factory restraints are absent, there is, nevertheless, a very great superiority in the value of life in one class over another; . . . the only difference between the individual members being difference of employment or occupation.'

After some further statistical notes, Mr. Neison observes:—'It is evident that the residue of the population in the rural districts has a factitious value assigned to it, from being mixed up with the class called labourers; and that in any attempt to discover the relative values of life in different localities, unless employment were made an element in the comparison, an undue value would be attached to a great

portion of life in the rural districts,' where a large proportion of adult life is made up of agricultural and other labourers.

The net outcome, therefore, of Mr. Neison's statistical researches is, that agricultural labourers head the list of occupations in regard to the value of life. Mr. Ratcliffe accepts this conclusion with this reservation, that carpenters and joiners occupy a somewhat superior position, except at the age of twenty. And on referring to Dr. Ogle's comparative mortality table, it is seen that farmers, graziers, gardeners, and nurserymen have a lower comparative mortality figure than agricultural labourers. The same interesting table further shows that the latter present more deaths from phthisis, diseases of circulation, and respiration, and fewer from those of the nervous, hepatic, and urinary systems, and from alcoholism. *A priori* considerations will suggest this state of things, for the agricultural labourer has a harder life than his employer, and suffers more from phthisis, chest diseases, and rheumatism. On the other hand, the master lives better, and is commonly a free consumer of alcoholic liquors, and falls a victim in a higher ratio to nervous, hepatic, and renal lesions.

These statistics, in short, faithfully reflect the results of observation. Crippling and acute rheumatism, sciatica and lumbago, bronchitis, including what is termed asthma, and phthisis, are the prevailing maladies of farm labourers.

Additional observations upon this class of workers will be found in the chapter on Agricultural Occupations.

The vital statistics of *town labourers* yield, it is to be deplored, vastly different returns of sickness and mortality than do those of country labourers. The explanation of the result is to be found in the very unfavourable nature of much of the work the former are engaged in, along with their habits, modes of life, dwellings, and their general associations and surroundings.

From the subsequent division of this work, a very good idea may be obtained of the injurious nature of many of the occupations labourers are called upon to perform, and of the insanitary state of the places they work in. What, too, are the circumstances of their homes hygienically is constantly illustrated by the reports of medical officers of health for

towns. What are their habits and conduct is perpetually being exemplified in reports of philanthropic societies and of police courts.

And upon looking around at all such revelations, and thinking them over, we cease to marvel that the sickness and mortality of town labourers is so large. Dr. Ogle estimates their mortality figure at 2020, as compared with the standard of 1000 for all males, and finds them to have a mean mortality between the ages of twenty-five and forty-five of 20·62, and between those of forty-five and sixty-five of 50·85. Here, unfortunately, the official source for their statistics ends, and both Neison and Ratcliffe supply no further information, saving that Liverpool labourers are in a worse plight sanitarily than those of London.

The list of labourers, as returned in mortality reports, will include many individuals thoroughly broken down in health and strength, labourers only in name; or else so called because another appellation was not forthcoming or not politic, and who are nothing more than the waifs and strays of humanity, demoralised, and dead physically while yet they live.

Should an inquiry be instituted to discover the diseases to which death is mostly due, I have the conviction that, in all essential points, it would yield results similar to those found for costermongers and street hawkers. The outdoor case-books of the great London Hospitals ought to furnish ample material for such an investigation.

ORDER 14.—*Costermongers, Hawkers, and Street Sellers* represent a body of people whose occupation is scarcely definable, and is likewise repeatedly changed. They form an irregular band of small traders, of wandering, and, for the most part, irregular, if not intemperate habits, whilst their sale of goods is accompanied by more or less excitement and noise, and by inevitable exposure to weather. They are harassed by uncertain gain, and are often in great strait for the means of living; whence it happens that their homes are located in the poorest quarters of a city, and possess usually little comfort or cleanliness. The public-house is their

haven of rest and enjoyment, and they live for the day and not for the morrow, reckless of the future, and little heedful of the present in matters affecting their bodily and mental well-being.

The one advantage they enjoy is the outdoor character of their employment; but its benefits are greatly curtailed, so far as town hawking is concerned, by the frequent pursuit of their trade in crowded and insanitary courts and streets. Besides, in their own homes, which are little used except for night lodgings, their otherwise unhealthy air is very commonly made worse by the lodgment—often under the bedstead—of unsold articles left at the end of the day's adventure, and which, when animal or vegetable products, are not infrequently in a stage of partial decomposition.

Of none of the struggling traders in question have the vital statistics been specially examined. They constitute the larger proportion of hospital and dispensary patients; but, as no satisfactory registration of occupations and diseases is made in those institutions, data are wanting to demonstrate the prevalent diseases and their probable causes. Exposure to weather, prolonged standing and sitting in the open air, insufficient food and clothing, and in their homes the absence of most or all sanitary requirements, are doubtless the principal causes of the sickness, suffering, and mortality of the class in question.

However, we have here again the advantage of the valuable official figures and remarks of Dr. W. Ogle. And bearing in mind the surroundings of these people, we are prepared to find an exceedingly high rate of sickness and mortality. The only members of society who exhibit a higher scale are the general labourers of London, whose comparative mortality figure is 2020, that of the class under notice being only 1879. Between twenty-five and forty-five the mean annual death-rate per 1000 living is 20·26, and between forty-five and sixty-five it is 45·33. For the term of life last-named, the mortality is exceeded in the case of potters and file-makers, of Cornish miners, and inn and hotel male servants.

The table of causes makes it clear that phthisis and respiratory maladies are the chief causes; one-fourth of the deaths being due to the former, and nearly the same

number to the latter. The comparative death-rate from phthisis is 475, as contrasted with 220; and from diseases of the respiratory organs 420, instead of 182. In regard to these maladies the health-history of costermongers and hucksters is more unfavourable than that of cab and omnibus men. On the contrary, the latter exhibit a greater proportion of deaths from liver diseases, gout, alcoholism, and accidents; whence follows the inference, that they are more given to strong drink. The exposure to inclemencies of weather, often insufficiently clothed, and to insanitary surroundings in their homes and in the streets, coupled with a precarious livelihood, is accountable for the larger mortality of hawkers and costermongers from respiratory maladies.

The frequency of death by suicide is remarkable. It is greater in this than in any other section of employed people, and may be partly accounted for by the misery that waits upon non-success and the maddening influence of drink. The nearest approach made by any other occupation is instanced among commercial travellers, with whom the comparative figure is thirty-one, instead of forty-four as among costermongers. And Dr. Ogle's table of 'industries with highest mortalities from certain selected causes,' demonstrates further that costermongers head the list in the array of deaths from circulatory maladies, stand second for nervous disorders, fourth for urinary affections, sixth for alcoholism, eighth for gout, and tenth for liver lesion.

It may be said of a large proportion of people thus occupied, that they represent the wrecks of civilised society, maimed and despoilt against the rocks of misfortune, or stranded on the sands by reckless living. In so far as this is true, so far, in equal degree, does it hold good that the lives so dragged down into the lowest stratum of civilised existence are lives that have lost their normal vitality, and must add to the total mean mortality of the whole group to which they belong.

Dr. Ogle pertinently remarks (*op. cit.* p. 35):—'Doubtlessly, both among cabmen and among street hawkers, there are men of good health and steady habits who have taken to the occupations as their original means of living; but there is also most certainly in both of

them a very considerable proportion of men who have only taken to the occupation as a refuge, having fallen from some superior status in consequence of ill-health and evil ways. The high mortality, therefore, in these occupations is not attributable—at any rate, is not wholly attributable—to the nature of the occupation itself, which, for all that appears to the contrary, may be a very healthy one, but to the physical condition of the men who engage in it. Unhealthiness drives them into the occupation, not the occupation to unhealthiness.'

Though Dr. Ogle is perfectly right in these latter observations, it must be admitted that the accidental conditions of the calling above sketched, are prolific of disease, and, I apprehend, contributory in a higher degree to the death-rate than even the antecedent state of health.

Class II.—*Traders.*—Persons engaged in trading occupations, wholesale and retail.

It will be at once understood that the conditions of life in the very numerous occupations included in this group will possess some special characters for almost every one of them. Confinement to the shop or place of business, coupled with the want of outdoor air and exercise, is the most widely diffused circumstance among them. But apart from general conditions and accidental surroundings to be found in the sanitary state of the dwellings, there are certain features which must be esteemed incidental. Such exist in the articles of trade, in the requisite storage and arrangements for sale, in the customs connected with the business, and in the circumstance whether the trade is wholesale or retail.

As to the first-mentioned incident, it happens that one trader deals in animal, another in vegetable, and a third in mineral goods. Ofttimes, indeed, the articles traded in are of a mixed character.

The probability of a prejudicial action upon health is much the greater with regard to animal and vegetable matters used as food; inasmuch as all such are prone to decomposition, and to the consequent evolution of noxious vapours. Dealers in mineral matters get no harm from them unless they allow dust to accumulate in the atmosphere to the

damage of the respiratory organs; or unless those substances possess poisonous qualities, or are of an explosive nature, and so a possible cause of accidental injury.

In a large number of trades the working space provided is, from a sanitary point of view, far too limited. In such shops the air grows mephitic or poisonous, by reason of the consumption of its oxygen, by the progressive admixture of carbonic acid and of exhalations from those working in it, by the waste of consumed and unconsumed gas, and by whatever fumes are thrown from by the materials on sale. It is to circumstances of this nature, coupled with sedentary work, and too often deficient nourishment and intemperate habits, that we must look for the explanation of the heavy mortality of such a trade as that of tailors. According to Dr. Givre's tables of the comparative mortality of Lyons work-people, shoemakers and tailors, and still more tailoresses and seamstresses, present a higher mortality from tuberculosis than do silk artisans, notwithstanding the very insanitary conditions surrounding the latter operatives in the silk factories of Lyons, as heretofore mentioned.

There are some broad distinctive characters between trades which may help to classify them. There are trades, for instance, of a simple character, serving no other purpose than as emporia or stores for the convenience of purchasers. Such present no processes for the conversion or re-adaptation of the materials they are concerned with. Examples are seen in Manchester warehouses on a large scale, and on a small one in numerous retail trades; such as booksellers, drapers, dealers in earthenware and glass. Again, there are other trades in which certain simple mechanical processes or manipulations take place, whereby a certain measure of conversion or transformation of the plain, simple substance sold is effected. Among such are butchers, bakers, tailors, and others.

The occupation of chemist and druggist is another business unconnected with mechanical work, holding a unique position by its connection with pharmacy and chemistry, and the qualifications required for its exercise. The trade of painters and glaziers is also unmechanical, strictly speaking; whilst that of hairdressers occupies a peculiar position;

its 'professors' being neither producers nor vendors, nor converters of materials, excepting when they combine the art of wig-making with their primary function of haircutting and dressing.

Further, in the business of letterpress and lithographic printers, the majority of those employed are not concerned with exchange of products, and but little with mechanical work, beyond watching machines, worked by gas or steam, and acting often automatically. So, likewise, the work of bookbinders is of a simple mechanical nature, while that of compositors occupies a middle position between a simple occupation, calling for no activity other than that of the senses. Lastly, engravers emulate the position of artists by their skilled art work.

The majority of trades are in the hands of male persons: nevertheless, there is a group of them giving occupation chiefly to females; as, for example, millinery, dressmaking, laundry work, and the duties of assistants in the sale-rooms of drapers, pastry cooks, and other shops selling light articles it is needless to specify.

(*a*) *Retail Traders.*—The pervading feature of retail trades is that they are pursued within-doors, in shops or work-rooms. Exceptions are seen in certain of them where custom dictates open shops; as in the business of butchers, poulterers, and fishmongers. Partial outdoor dealing is also not unusual in the case of fruiterers and greengrocers. The truly indoor occupations have the obvious disadvantages attaching to sedentary labour,—using that term in its widest meaning, as signifying deficient exercise, an indoor existence, the want of fresh air, and of outdoor surroundings to gladden the senses. The semi-indoor trades suffer the ills arising from exposure to weather and draughts, and, in the case of the fishmongers' business, from incessant contact with water. Persons unaccustomed to visit the abodes of small retail traders, particularly of those who reside at their place of business, would be surprised at the frequent sordidness of their surroundings, the confined spaces left for living and sleeping accommodation, and the prevailing inattention to sanitary requirements. This even happens with retail shops,

driving a good trade; the shop and its accessories, along with the stock in hand, usurping the space needed for the comforts and the healthy conditions of life. Unlike the professions, retail trading makes no great demand upon the intellectual faculties, although it is far from exempt from anxiety and disappointment. When the latter happen to people whose mental and moral faculties have been little exercised, and whose one object has been to get profit, there is considerable danger of their minds becoming unhinged, and of the onset of insanity. The statistics of public asylums seem to show that a considerable proportion of their inmates have been retail dealers. Again, retail trade possesses no points of interest to the thinking mind, whilst it, at the same time, deprives its followers of the beneficial, genial influences of external nature. The mere act of buying and selling is a dull routine, and whatever gratification it affords arises from the low motive of pecuniary gain. Following in the train of these conditions is a predisposition to self-indulgence and an increasing indifference to outdoor exercise. In short, the circumstances connected with their business are, in the case of small retail dealers, paralysing alike to mental and bodily health and vigour. And when disease overtakes them, they exhibit small power of resistance. The maladies that most beset them are those connected with the digestive organs, and those of progressive general degeneration of tissues. Hence, for the most part, they age prematurely.

As a matter of course, these collateral incidents of retail trade prevail most diversely in different forms of business, and vary in effects according to the constitution and habits of individuals. The painstaking calculations made by Dr. Ogle (*op. cit.* p. 225) throw some light upon the vital statistics of retail trades. He brings forward eleven such trades; to wit:—Booksellers and stationers, chemists and druggists, tobacconists, grocers, drapers, and Manchester warehousemen, ironmongers, coal merchants, general shopkeepers, cheesemongers, milk and butter men, greengrocers and fruiterers, fishmongers and poulterers. Their mean annual death-rate, between twenty-five and forty-five, is 9·04; and between

forty-five and sixty is 21·90; and their comparative mortality figure, 877. This proportionate mortality, Dr. Ogle observes, is not high, considering such people reside in towns, get little outdoor exercise, and spend long hours in a more or less vitiated atmosphere in shop and house.

Arranging the eleven trades above quoted, their comparative mortality figures 'have the following sequence:—Coal merchant, 758; grocer, 771; bookseller and stationer, 825; general shopkeeper, 865; draper, 883; ironmonger, 895; fishmonger and poulterer, 974; tobacconist, 1000; milk, butter, cheesemonger, 1009; chemist, 1015; greengrocer, 1025.'

On contrasting these results with those of former years, he finds that in nine of them the ratio has fallen; the decline being greatest with drapers and fishmongers.

Dr. Ogle proceeds to say, that 'samples of the registered causes of death were taken for five of these trades, . . . but for only two,—the grocers and the drapers,—did the samples abstracted come up to 500 deaths, which was fixed as the minimum required for calculation of rates. Comparing the mortality from different causes in these two trades, it will be seen that the drapers suffer much more than the grocers from phthisis and diseases of the respiratory organs, and especially from the former; whereas the grocers have the highest mortality from diseases of the organs of circulation, as also in a smaller degree from alcoholism, liver diseases, diseases of the urinary organs, and suicide.' To account for these peculiarities of the two trades, he calls attention to the fact that many grocers deal in spirituous liquors, and, what is more to the purpose, that they are, as a body, older than drapers. The draper's assistant 'is a young man, and so soon as he reaches a certain age he must go. Now, both cardiac and hepatic diseases become much more frequent as age advances; and consequently we should expect to find, as we in fact do find, a greater mortality under these headings among the grocers than among the drapers. For it must be remembered that our rates are but imperfectly corrected for differences of age distribution.'

'The contrast between drapers and grocers in regard to their respective mortalities from phthisis and tuberculosis is not improbably referable in part to the very great differences observable between an ordinary draper's and an ordinary grocer's shop. The latter has, as a rule, the door wide open, and not being usually of great size, is thoroughly well ventilated. The draper's shop generally has the door shut, or at any rate not so widely opened as has the grocer's,

inasmuch as dust would damage the goods; it is of considerable depth and crammed with wares that are constantly being removed, and that give off fluffy dust during the process; the air is further fouled by numerous gas-lights required to show off the goods; and this vitiation is in most cases distinctly perceptible to the nose. Thus, probably, it comes about that the drapers' mortality from phthisis is one of the highest, whilst the grocers' is one of the lowest in our list' (*op. cit.* 38).

This interpretation is ingenious and satisfactory so far as it goes. But it may be supplemented by the further reflections that the drapers' business, by its apparent lightness, its presumed social superiority, and its attractiveness, will contain a larger ratio of feeble lives than the grocers; that in large drapery establishments the assistants are lodged on the premises, and not always under the most sanitary conditions; and that, as the proportion of youthful lives is greater, a larger ratio of phthisis may be anticipated than where, as in the grocers' trade, the average age is higher.

The foregoing extracts from Dr. Ogle's masterly statistical contribution forms a fitting prelude to the following account of retail trades taken severally. These trades are many and diverse, and the consideration of their health conditions suggests their separation into orders or sections. Nevertheless, several of them are not to be reduced to system, and must figure by themselves.

SECTION A.—The first distinct sub-order of retail trades is that concerned in *the preparation and sale of articles of food and drink.* It admits of sub-division according as those articles are of animal, vegetable, or of a mixed character, or are products of fermentation or distillation, and alcoholic.

B. The second is represented by the business of *retail Chemists and Druggists.*

C. A third section consists of traders dealing with articles of clothing and with *textile goods in general.*

D. A fourth comprises tradesmen who sell *books* and *stationery.*

E. A fifth includes dealers in *metal goods.*

F. A sixth comprises a *miscellaneous* group of trades not reducible to either of the foregoing sections. In it are to be

numbered retail dealers in china and glass, in bric-à-brac, and toys.

G. A seventh section of very distinctive character is represented by the business of *Hairdressers* and *Wigmakers.*

It will, to some extent, be impossible to examine the health conditions of retail business or barter entirely apart from those concerned in producing the articles sold. However, the endeavour will be made to exclude for the occasion truly manufacturing operations.

A. *Retailers of Foods and Drinks.*

i. *Of animal food,* represented by butchers, pork butchers, fishmongers, and poulterers. Speaking of dealers in animal food at large, Mr F. G. P. Neison remarks that a high mortality obtains among them (*British Association Transactions,* 1868, p. 174).

1. *Butchers.*—Under this heading may be included all tradesmen having to do with the preparation and sale of animal food—carcase butchers, meat salesmen, retail butchers, pork butchers, sausage-makers, and slaughterers. These divisions of the business have certain common hygienic conditions, though not decidedly similar. In small towns and villages those distinctions do not prevail. It is at once evident that meat-salesmen present conditions of occupation diverse from those of slaughter-men. The former occupy the position of middlemen, who have practically little to do with the article they deal with. The latter are a class of rough labourers, whose work is not calculated to improve their health or their manners, and exposes them at times to contamination from diseased animals. Apart from these considerations, the sanitary state of slaughter-houses is not always satisfactory, and the nature of the occupation is such as to furnish an incentive to drink. Some of the old writers on occupations affirmed that the odour of meat, especially when in a state of decomposition, was a cause of sickness; but in so doing they overlooked the effects of the sanitary surroundings and habits of butchers.

The chief hygienic features of the butchers' trade are, exposure in more or less open shops to the inclemencies

of weather, considerable exertion in lifting the carcases of the slaughtered animals, the long standing, and injuries by cutting. Judging from the comparative figures presented by Dr. Ogle, fatal accidents are not many, being accountable for only thirty-five, as contrasted with sixty-seven for all the occupations dealt with in the table. Nevertheless, it is a heavy figure in comparison with what obtains in the case of almost all retail trades.

London butchers commonly buy from meat salesmen and carcase butchers; but in country towns it is the common practice to buy live cattle at surrounding markets, and not infrequently to associate the business of cattle-dealer with that of butcher; when this is done, more or less travelling is necessitated, with its risks to health from very early rising, exposure to weather, and irregular rest and diet. Another accident of the trade is the inducement to take strong drink. Every bargain has to be sealed by a potation, and the conviviality of the market dinner at the inn adds to the amount of alcoholics consumed.

Again, there is no doubt that butchers generally consume flesh meat in excess, and get at the same time too little active bodily exercise out of doors. For, as they are almost always keepers of vehicles, they undertake little walking. Combining, therefore, these circumstances with usually the free indulgence in fermented liquors, it is not surprising to find them over-fat and over-full. Another minor circumstance is the proclivity to eat fragments of uncooked meat. This incident explains their being not infrequent sufferers from entozoa, especially when the meat is pork, seeing that swine flesh is oftener than other meat infested with them.

Medical experience also points to butchers being more prone than other tradespeople to erysipelas after wounds, as well as to inflammatory cutaneous eruptions, and to boils and carbuncles, and, generally speaking, to acute inflammations. The last statement is supported by the statistics collected by Hirt, and according to which it is especially true of pneumonia. Patissier adds that the strong muscular efforts and strain, often demanded, entail, at times, hernia, aneurism, and laceration of muscular fibres; but he produces no figures demonstrative of the fact. If it be true, it will apply chiefly

to carcase butchers and slaughterers. The liability to contract contagious disease from handling diseased meat and hides has been referred to.

Rheumatism finds no place in mortality official tables, because it is rarely the proximate cause of death. Still, in my opinion, it is, in a chronic or in an acute form, a common ailment with butchers. Dr. Ogle's figures make it clear that gout is accountable for many more deaths among the tradesmen in question than in most occupations.

'Their comparative mortality figure is as high' (writes Dr. Ogle, *op. cit.* p. 38) 'as 1170. . . . The high mortality of butchers is manifestly due to excessive indulgence. Their mortality from alcoholism, liver diseases, and urinary diseases, respectively, is almost identically the same as that of brewers. So, also, is their mortality from diseases of the nervous system. But under the headings Phthisis and Diseases of the Respiratory System their mortality falls far short of that of the brewers. Still, even under these headings their mortality is high, and especially under the heading Phthisis.' Dr. Ogle proceeds to controvert the popular impression, handed down for a series of years by Thackrah and others, that phthisis rarely attacks butchers. On the contrary, it figures in his tables as 261, against an average of 220 for all trades, 'and in this respect butchers agree with other trades in which there is evidence of alcoholic excess.' He, moreover, points out that his statistical results coincide with those of the published Swiss returns, which assign to butchers the fifth place among trades ranged in the order of their mortality from phthisis, beginning with the highest (p. 39).

Dr. Farr, in the course of his observations on the heavy mortality of butchers, remarked that those of them in business in London stood highest in the scale; a fact to be accounted for by urban residence and by the greater inactivity of their lives. Yet though their death-rate be high, they are not, according to Neison, subject to above the average amount of sickness. In fact, Ratcliffe's calculations lead to the inference that, clerks excepted, butchers presented a less average amount of sickness than any other class of tradesmen.

But in applying the test of relative sickness attaching to different occupations, it is most needful to bear in mind Neison's remark—that whilst it is easy to apply the test of mortality to various localities and employments, it is not

so to appeal to sickness returns as an index to the sanitary condition of any trade or locality. For 'what constitutes sickness in one case is often a very different thing from that in another.'

2. *Fellmongers.*—Indirectly connected with the employment of the butcher is that of fellmongers, of which some account will hereafter appear when dealers in leather are under notice.

3. *Drovers*, again, have a certain connection with it, but are rather to be classed among labourers; and as no vital statistics are available respecting them, it is enough to note that, as a class, they are men of irregular, roving life, neglectful of personal cleanliness, greatly exposed to weather, and mostly very intemperate. Could we get at facts respecting them, it may be assumed as certain that they would occupy an exceedingly low position in the scale of health.

4. *Fishmongers and Poulterers* have several conditions of occupation in common with butchers. Both deal with animal products, and exercise their trade in shops more or less open. The joint death-rate, however, of the two trades is less heavy than that of butchers, being 974, as contrasted with 1170. So far as fishmongers are concerned, this estimate differs from Dr. Farr's, namely, 'that fishmongers experience full as high a mortality as butchers' (*op. cit.* p. 55), and bearing in mind that of the health conditions of the two callings, those of the fishmonger are decidedly less favourable, we are disposed rather to agree with Dr. Farr. The fishmonger, both when buyer and seller, is more exposed to weather than the poulterer, and especially to contact with cold water and ice in handling fish. And, as men in the trade assure me, they incur rheumatism in their hands and arms, even when they are fortunate enough to escape it in its general form.

Another reason for expecting a higher fatality among fishmongers than among poulterers is, that the former,—as returned in registers,—embrace a far more miscellaneous class of people, and a larger proportion of the lower grades,

whose habits and modes of life are adverse to health. And if the foul smells of decomposition are ever hurtful, we may expect to see it exemplified rather among fishmongers than poulterers and butchers.

ii. *Dealers in vegetable produce.*

1. *Greengrocers and Fruiterers.*—The business of these tradesmen has no very special sanitary features. Like that of grocers, the occupation has a multitude of grades, passing downwards from that of the flourishing fruiterer in a large city, to that of the street hawker; and, as a result, it presents very varied health-conditions, irreducible to a common standard. Leaving the hawkers out of sight, the retailers of fruit and vegetables are less exposed to outdoor causes of sickness than are butchers, and are likewise, as a class, more regular in their habits and more temperate, inasmuch as their occupation calls for less travelling, and is more exempt from the sway of trade customs.

In Dr. Ogle's table, the comparative mortality figure for these tradesmen is 1025, and therefore exceeds that of the eleven retail trades selected as examples, and, likewise, that of the majority of occupations of all kinds,—including fishmongers and poulterers. This fact seems somewhat remarkable; but we may look for a partial explanation of it from the following considerations. The trade is one accessible to any individual seeking to gain a livelihood; it requires no training and very little capital to start in it; and under the head of greengrocers will be included in mortality returns not a few whose position is rather that of hawkers of fruit and vegetables. Moreover, excepting in shops in first-rate positions in towns, greengrocers, so called, carry on petty trade in crowded and unhealthy streets, to the insanitary circumstances of which those of their own shops, very often most ill-kept and redolent with the fumes of decaying vegetable matter, are superadded.

2. *Bakers, Confectioners, and Pastrycooks* represent a body of tradesmen exhibiting hygienic conditions of a common character, the principal of which are:—Exposure to heat from the ovens, dust, steam, variations of temperature, in too many instances unhealthy bakehouses, fatiguing movements

necessitated where kneading is done by hand, disagreeable emanations from materials used, prolonged hours of work, more or less night-work and loss of rest. To these evils of their trade the working bakers often add intemperance and irregular living. My own senses also make me conscious of a disagreeable sickly smell, much like that of heated bones, superadded to the steam and other fumes. There are, in brief, many incidents in the occupation of baking, which reduce vital energy, predispose to lung-affections, and shorten life. But we ought to distinguish between master and journeyman bakers. The former are mostly fat and flourishing, whilst the latter are anæmic and sallow, in general appearance worn out, and in mental features dissatisfied and despondent.

This opinion does not harmonise with the deductions made by Mr. Ratcliffe from his researches into the statistical records of the *Oddfellows' Friendly Society* (*Manchester*, 1850, pp. 39-42). According to his finding, 'Bakers show an equal vitality in comparison with the general results of the "Unity" and the entire population; . . . and they have a less aggregate amount of sickness, and a higher general expectation than is evidenced from the general results of the whole of the lives combined.' It must be apparent that Mr. Ratcliffe's conclusions come out more favourably, for this reason, that the members of the 'Manchester Unity' represent the better and more careful section of the baking fraternity, and not the working bakers' men. In confirmation of the general principle that the rate of sickness does not coincide with that of mortality, Mr. Neison observes,—'Bakers, at the early and middle periods of life, are less subject to sickness than the general average, and among them there is a higher mortality.' On this latter matter, therefore, the two eminent statisticians differ. Some further information regarding the diseases of bakers is obtainable from Mr. Harden's *Mortality Experience of the 'Prudential Assurance Company'* for the four years 1867-71.

The discrepancies noticeable in the vital statistics of bakers compiled by different authors, may in some measure be reconciled by recognising the circumstance that bakers, *quoad* the work of baking, which is the primary health-element, differ widely among themselves. It is a kind of labour entered upon very largely by young men, but ofttimes

followed up only for a while on account of its injury to health. That the labour in bakehouses is very damaging to health and shortens life is well known to the trade, and causes it to be given up whenever circumstances permit. The *quondam* working baker becomes a master baker, or, if this position be unattainable, he takes up some other employment. In very many instances the life so transferred is a damaged one, and consequently whilst, on the one hand, its transfer enhances the mortality and sickness ratio in the assumed occupation, on the other, it makes that of the abandoned trade appear less. The disturbing effect of this exchange of occupation on statistics is, moreover, naturally the greater, because the new lives introduced will be, for the most part, younger and sounder.

The death-rate of bakers, pastrycooks and confectioners, although still ruling high, has fallen of late years in a slight degree, and is now represented by the mortality-figure of 958. That of millers is almost exactly the same. The returns of the causes of mortality point to the abuse of alcoholic drinks by bakers. Deaths by suicide are in a very high ratio, but as regards phthisis and respiratory diseases, these tradesmen do not surpass the average for all males. Dr. Ogle adds:—'Judging from the death-rates of millers and bakers, the inhalation of flour-dust would seem to be innocuous; probably little, if any, of the dust inhaled reaches the lungs.' (*Op. cit.* p. 39.) We feel obliged to differ from the learned writer on this point, there being ample evidence of flour entering the pulmonary tissue and setting up chest affections. *Certes*, in the vastly improved construction of flour-mills, and by the introduction of automatic machines for grinding corn and separating it from its comparatively waste products, the evils of the miller's trade have been most materially reduced, yet withal not exterminated.

Those who have read the reports on the hygienic state of bakehouses, and the circumstances of labour in them, will not be surprised that the mortality of bakers ranges high. As to the exposure of bakers to flour-dust, it is neither considerable in extent nor long in duration. Layet calls attention to the powerful and repeated movements imposed upon

the men in kneading bread upon the old system; the forcible bending of the trunk forward, the pressure against the stomach, and the strength of arm called for. These actions, he asserts, cause heart-disease and emphysema. Dr. Ogle's table partially bears out this conclusion. Thus, of 629 deaths, cardiac lesions were the cause in 86, or 13·6 per cent., certainly a somewhat high ratio; nevertheless little in excess of that occurring with shoemakers, with whom it equalled 12·4 per cent., although in the case of the latter there is an absence of very strong movements of the arms and trunk, other than those required in the act of stitching. Malgaigne assigned to bakers a high ratio of hernia, and others again speak of a remarkable susceptibility to fevers and epidemics, and to gastro-intestinal disorders. The last-named amount, according to Layet, to 20 per cent. of the internal maladies they suffer; whilst in Hirt's experience of 100 cases of sickness among them, 28·2 per cent. belonged to the respiratory apparatus. Lastly, Thackrah, really upon the authority of older writers, represents bakers as unusually subjects of rheumatism, an opinion we cannot substantiate. Though some, chiefly among master bakers, get fat, the majority of these tradesmen are thin; and it is another prevailing phenomenon among them, that they are anæmic. Layet quotes Mayer's statistics of the dimensions and weight of bakers drawn in the conscription in Bavaria, from which it appears they were nearly at the bottom of the list among workmen taken from active occupations.

Among minor evils attending the baker's trade, Ramazzini and other writers describe an expansion and development of the hands and digits, and thickening of the skin over the joints, due to the pressure in kneading the dough. This peculiarity will be, ere long, a matter of history, as hand-kneading is being fast replaced by machinery. In fact, the whole details of bread and biscuit baking are being rapidly metamorphosed by this agency, to the sanitary gain of bakers and to the advantage of cleanliness. Proceeding *pari passu*, is the remodelling of bakehouses as prompted by the same influence, and their development into factories, with the attendant result of the progressive destruction of the miserable, filthy, and unwholesome dens in which baking has been

done in past years. The large biscuit-factories of the kingdom demonstrate the practicability of removing every tangible sanitary evil from the occupation of the baker.

Mr. Ratcliffe says of bakers, that their mortality from diathetic diseases is the largest for all occupations; whilst nervous diseases are common among them; and, in relation to the frequency of respiratory diseases, they follow third in order, being preceded in the list only by potters and brickmakers; whilst in regard to developmental maladies they head it. As to diseases of the digestive organs, they suffer beyond the average.

A complaint more common among bakers formerly than at present was the so-called 'bakers' itch,' appearing upon the hands, wrists, and fingers. It also occurred among millers, and in both instances was attributable to the irritation of the flour, and, in a larger degree, to want of cleanliness. In some cases there was probably true scabies, but, for the most part, the eruption had the character of eczema.

Another lesser evil found among bakers is, according to Hesse of Leipzic, carious teeth. This fact he accounts for by supposing that flour entering the mouth during work collects on and around the teeth, where it suffers decomposition, and generates an acid destructive of the dentive. This hypothesis seems to me rather ingenious than probable, and I consider the statement made requires confirmation.

iii. *Dealers in Miscellaneous Articles of Food.*—Of such are grocers and provision-dealers: the former in towns form a distinct body of tradesmen; but in the poorer parts of towns and in most country places the two divisions of the business are combined. Nevertheless, it would be a mistake to lose sight of the divergencies in health aspects which exist between the several forms of occupation which are usually classed together under the common appellation of the grocery business. At one end of the series stand tea and coffee dealers, who represent the aristocracy of the trade; at the other are placed the large band of grocers and provision dealers, displaying a very miscellaneous assortment of goods, suited to meet all the requirements of humble households as well in eatables as drinkables; alcoholic drinks included.

In fact, the village grocer is often the purveyor also of drapery and of drugs as well as chandlery. In very numerous instances the retail sale of bread is another section of his business.

A moment's reflection on these facts will make it plain that the health conditions of a first-rate grocer's shop in London or other large town, where tea and coffee are the only articles dealt with, and where the premises are of ample dimensions for trade purposes, and those of a small provision-dealer's shop in a back street or a small village, are widely different. And it is such differences that render sickness and mortality statistics calculated on the heterogeneous body of people returned as grocers unreliable. It must, at the same time, be admitted that particular statistics for the several marked divisions of the trade are unattainable; for one merges almost imperceptibly into another. The deductions to be made from the Registrar-General's mortality returns have been already recorded.

The task of discovering for any particular department of retail trade what special disadvantage, if any, belong to it in the matter of health effects, is almost daily becoming more difficult owing to the coalescence of a multitude of such trades in one common establishment, known as a 'store.' However, Dr. Ogle has sought to discover the comparative mortality of 'cheesemongers, milk, and buttermen' united in one group; and of 'tallow-chandlers and soap-boilers,' as another group, with the following results:—

For the former group he finds the death-rates between 25 and 45, and between 45 and 65, to be respectively 9·48 and 26·90; and for the latter, 7·74 and 26·19. With regard to the comparative mortality figures, they are respectively 1009 and 920. Taking the whole period between 25 and 65 years of age the two trades stand much on a par, though the comparative mortality of vendors of cheese and butter rules higher. Further, on comparing these figures with those expressive of like results for grocers, the outcome is, that the last-named are a healthier body of tradespeople—the corresponding figures being 8·00, 19·16, and 771. Whence we may conclude that the sanitary conditions among cheesemongers, buttermen, and tallow-chandlers, are less favourable than

among grocers. Nevertheless, knowing how unsatisfactory returns of occupation are, we assign small importance to the apparent fact, where trades, as in the examples before us, are so intermingled.

Grocers who handle sugar are prone to get an eczematous eruption on the back of the hands and on the fingers, which has been called 'grocers' itch.' It has probably happened in some instances that actual itch has been met with; but in such cases the disease cannot be attributed to the substances dealt with, but to contagion and want of cleanliness.

iv. *Dealers in Spirituous and Malt Liquors.*—In the case of these tradesmen, no ambiguity exists regarding the unfavourable position they occupy in health statistics, or as to the cause of this fact. Though brewing and distilling be manufacturing processes, and are often conducted on an enormous scale, yet as they have few appreciable health features other than those connected with the consumption of the articles produced, it will be well to include what can be said about them in this place.

First, as regards publicans or licensed victuallers. The factors concerned with their state of health and their mortality are:—Abuse of the beverages they deal in, indoor lives of little activity, and the influence of bad trade customs. There is a consensus on all hands that the value of life among publicans stands near the bottom of the scale, when all trades are tabulated. Quoting again from our best authority on trade statistics, Dr. Ogle observes:—

'The mortality of men who are directly concerned in the liquor trade is appalling; the comparative mortality figure for brewers being 1361; for innkeepers, publicans, and generally all dealers in spirits, wine, or beer, 1521; and for inn and hotel servants, no less than 2205; whereas for maltsters, who only are concerned with the materials and not with the liquor itself, the figure is only 830. The death-rates for inn and hotel servants were much higher in 1880-82 than in the former experience; whereas the death-rates of the brewers and the publicans, high as they are, nevertheless show a not inconsiderable reduction.' (*Op. cit.* p. 36.) To illustrate further this sad state of things, Dr. Ogle refers to the experience of the Scottish Amicable Life Assurance Society, according to which dealers in

intoxicating drinks have a mortality of 68 per cent. in excess of the Actuaries or Health Male Table, and 49 per cent. in excess of the English Life Table (No. 2 Males). This result tallies very closely with the figures in Table I., where it appears that the mortality of the innkeepers and publicans is 52 per cent. above the present mortality of all males. . . . The mortality attributed to *alcoholism* itself is far higher for innkeepers and publicans than for any other industry, and more than five times as high as the average; that for brewers falls far short of this, but nevertheless is the next highest to that of innkeepers, with the single exception of cabmen.'

These facts point clearly to alcohol in its various forms as the active cause of the destruction of life.

One cause of the difference in results between innkeepers and brewers, Dr. Ogle finds in the circumstance that the former indulge in spirits as well as in beer, it being universally admitted that the former are more detrimental to life and health. There is this amount of consolation respecting the matter under notice—viz., that if all dealers in drink were intemperate, the mortality figure for their trade would be vastly enlarged. For, according to Mr. Neison, the comparative mortality figure of recognised intemperate people is 3240; whereas that of publicans does not surpass 1521, or, in round figures, less than half what, on the supposition of their universal intemperance, it would be.

The late Dr. Farr (*Supplement to the thirty-fifth Annual Report of the Registrar-General*, p. 54) commented at some length on the death-rate of publicans, and presented a table showing how this stood related to that of butchers, and what was the relative mortality of these tradesmen according as they lived in London or the country. The deductions therefrom are, that the mortality ratio is greater for London than for country publicans and butchers; that it is greater for the former tradesmen than the latter, and that it assumes its remarkable development in both businesses, after the thirty-fifth year of age has been reached, and persists until the sixty-fifth year, after which it declines. Another fact made out is, that butchers' boys and pot-boys, aged between fifteen and twenty-five, have a relatively lower mortality than youths of like ages in the community at large. The diminution of the mortality-rate of publicans and butchers after the sixtieth

year of life will signify that the worst lives—morally and constitutionally—in the two occupations have lapsed, leaving a residuum with superior vital power.

On comparing the most recent statistics of mortality with those of previous years, it is satisfactory to find that the ratio of death among the tradespeople in question is decreasing; whence we may infer that there is less intemperance among them than formerly. Yet, if this be true, it will not be prudent to attribute the improvement to wider moral control—or at least the whole of it—because in recent times the stringency of the laws governing licensed houses has been largely augmented; and a drunken landlord is exposed to serious penalties, terminating in the forfeiture of his licence.

When we come to inquire as to the diseases causing the heavy mortality of publicans, we meet with a group of maladies well known to medical men as consequences of alcoholic poisoning. Indeed, Mr. Neison, on the strength of numerical returns from various sources, shows statistically that, in the intemperate class of lives, there is an excessive preponderance of diseases of the nervous system and of the digestive organs.

'In England and Wales, these two groups form 15·950 per cent. of the deaths from all causes at the corresponding ages; but amongst intemperate persons, they form 50·40 per cent. of all the deaths which take place, or more than three times the general average. These may therefore be regarded as the distinctive type of the causes of death among intemperate persons; and the predominance of deaths assigned to such causes in any particular collection of facts, may fairly, in the absence of other and more direct evidence, lead to the inference of irregularity of habits having prevailed to an unusual extent.' (*Op. cit.* p. 222.) This corollary likewise finds a place in the account of the diseases of tobacconists. Again, from facts collected, Mr. Neison calculated the duration of life among beer-drinkers and spirit-drinkers respectively, and among those who drank both spirits and beer indiscriminately. The figures that came out indicated an average duration of life, after the commencement of intemperate habits, of 21·7 years for beer-drinkers; of 16·7 for spirit-drinkers; and of 16·1 for those who took both beer and spirits. 'Consequently (he adds) the rate of mortality will be, among beer-drinkers, 4·597 per cent. yearly; among spirit-drinkers, 5·996; and among

mixed drinkers, 6·194 per cent. Intemperate indulgence in the use of distilled liquors is hence more hurtful to health than the like use of fermented liquors; but the immoderate use of both combined is more injurious than the exclusive use of the one kind only.' (*Op. cit.* p. 218.)

These conclusions derived from statistical calculations are in complete harmony with the teaching and experience of the medical profession. Excepting only costermongers and hawkers, innkeepers and publicans have the highest mortality figure from diseases of the nervous system, of all occupations, namely, 200; alcoholism figuring for the goodly number 55, as compared with 10 for males generally. Urinary diseases are unusually high, being as 83 to 41; but liver diseases have the bad pre-eminence in frequency, their comparative mortality figure being 240; whilst that from all causes is 1521, pointing to the fact that little short of one-sixth of the entire mortality of these tradesmen is due to hepatic diseases. Using comparative mortality figures, the ratio is as 240 for publicans to 39 for the entirety of males in England and Wales. Again, gout shows the highest number among all the occupations in Dr. Ogle's table, being 13 instead of 3. Phthisis again, which Neison regarded as somewhat rare among the tradesmen in question, is represented by 295 as contrasted with 220; and respiratory diseases stand at 217 as opposed to 182.

The survey of the health conditions of these tradesmen would be incomplete if other tangible causes of sickness were omitted. The most obvious is their great, and often almost unbroken, confinement to the house. Their business is carried on for long hours, amidst a blaze of light to make it attractive, in apartments frequently very ill-ventilated and filled with the fumes of tobacco, beer, and spirits, as well as with the breath and general emanations of customers, who, for the most part, are largely indifferent to cleanliness in person and clothing. Accompanying the foregoing conditions are noise and excitement, and scenes of misery, degradation, and vice, painful to every one of ordinary moral sensitiveness. They also undergo perpetual anxiety in keeping order and in avoiding acts which might involve them in the meshes of the licensing laws. The hotel-keeper may escape many of the

evils felt by the common publican, but he has responsibilities and anxieties of his own in working a large establishment, in controlling servants, and in satisfying his lodgers.

The incidents of the life of a publican as above sketched, do not stand alone. The man is perpetually in the way of temptation to take stimulants, and the temptation is increased by the depressing influences surrounding him; by the fatigue of standing, by the loss of appetite, and the sensation of sinking which a portion of spirits can so readily relieve, and, for a time, steady the hands, and strengthen the legs which previous potations have weakened. In fact, no one acquainted with the every-day trying life of an innkeeper, can feel surprise that he should become more or less a drunkard. Not, indeed, usually a helpless or noisy one, but a drinker of stimulants, for the most part, in small quantities, yet many times a day; frequently with no food in the stomach, and often taken in the place of food, when the jaded stomach refuses proper solid diet—a circumstance especially notable at the morning meal.

To this list of the evils of the business must be added the wretched custom of drinking with customers for the sake of politeness and goodfellowship; and another minor incident, small indeed, yet not without possible injury to health, the cellar-work called for 'fining' and mixing, and—may it be said without committing a libel—adulterating their goods. As to this last circumstance, it must be remembered that public-house cellars are mostly damp and cold, and pervaded by deleterious gas—mostly carbonic acid from the fermented liquors; and that the landlord commonly divests himself of his coat when performing his task. Medical men, practising among these beer-dealers, can speak from experience of the chest ailments not infrequently produced by the duties performed in the cellar.

To complete the sketch of the ills of the public-house business, it has to be added that commercial travellers, publicans, bakers, and butchers head the list in tables showing the comparative frequency of suicide among the various occupations; excepting, indeed, the miscellaneous group entered as costermongers, hawkers, and street-sellers, whose misery will explain the preponderating ratio of self-murder found among them.

Collateral circumstances affecting the vital statistics of publicans are discoverable in the class of society which furnishes a large contingent to the trade; for instance, men who have failed in other occupations, or have had to lay them aside by reason of increasing physical inability. Again, the rivalry of brewers has caused them to buy up licensed houses, in which they put mere caretakers at small wages, or on small commission on the sale effected, who differ widely from the old-fashioned landlords owning their own houses, and besides, are taken from a lower social grade. This transformation of the business is fraught with evils to society by favouring irregularities both among sellers and consumers.

When the statistics of the trade are discussed, it is imperative to remember that no mean proportion of publicans have not entered on the calling until of quite mature or even advanced years, and that not a few have previously fallen into habits of self-indulgence and intemperance.

As a matter of course, the picture drawn of the sanitary surroundings of dealers in beer and spirits, does not apply to all engaged in the trade; indeed, its general darkness need be lighted up by some bright examples to be found among beer-sellers, licensed victuallers, and inn and hotel-keepers. Necessity compels the grouping together of both bad and good specimens, for particular observations respecting the vital statistics of this or that branch of the trade are wanting.

At the outset of this chapter, differential features were noted in the extract made from Dr. Ogle's paper, between publicans as compared with brewers. The latter, we learnt, had a comparative mortality figure of 1361, as against 1521; but on turning to the table of causes of death, we observe that, if brewers suffer in a less ratio from alcoholic troubles, they present a higher mortality from diseases of the circulatory system, from phthisis, and from respiratory maladies. This diversity is, as to the first and last named, to be accounted for by their greater exposure to variations of temperature and to moisture, steam, and by the demand for greater physical exertion—in other words, by conditions certainly favourable to the production of rheumatism and bronchitis, and of cardiac strain. Their figure for phthisis is 334, as contrasted

with 295 in the case of publicans. Why this greater proclivity to phthisis among brewers does not appear; but we surmise that, in the returns of mortality for brewers, a considerable proportion entered under that appellation are nothing more than brewers' servants, including many draymen, whose modes of life, exposure to weather and irregular living, are well calculated to break down health and precipitate consumption.

Once more, brewers and distillers exhibit a greater liability to accidents in carrying on the processes of brewing and distilling. They incur scalding, and still oftener suffocation with the carbonic gas collected in the vats they are called upon to clean. Accidents by falling from heights, and occasionally into the vats of boiling liquor, are also among the perils besetting their occupation. And brewers' servants, in the shape of draymen, are in frequent danger from the casks they lower or lift out of cellars. Another incident in the history of brewers' workmen is, that they bear sickness badly, and that slight injuries are apt to be attended by serious consequences.

Class 8 in Dr. Muirhead's arrangement includes 'wine merchants, brewers, distillers, innkeepers, licensed victuallers, and all connected with the manufacture and sale of alcoholic liquors.' Heart-diseases stand foremost in the order of fatality; surpassed only in the case of clergymen. The average for this class being 15·287, and that for the latter, 17·134; the general average being 12·879. Apoplexy follows next with the relative figure of 10·828, compared with 9·119. Next in order are diseases of the kidney and of the liver, the average in each of which is greatly in excess of the general one calculated on the whole male mortality. The former stands at 8·280, compared with 4·269; the latter at 7·643, contrasted with 4·941. Other diseases of the circulatory system, cancer, and enteric fever, are in excess; whilst consumption, occupying the eighth place, has a comparative average of only 6·369, in place of 9·519. Bronchitis again, is rather more than half of the returned average, and fourteenth in position; and pneumonia, in the tenth place, is represented by 5·096, instead of 6·848. The high fatality position of renal and hepatic maladies is what would be

looked for. Diseases of the digestive system might be expected to exceed the average. This, however, is not the case, for these last appear with the average of 2·548, instead of 5·468.

The conclusion is inevitable that these averages show a more favourable state of things among the class of tradesmen under consideration, than other statistics furnished, and for this reason, that the lives here statistically examined, are those of individuals accepted as insurable, whereas we know that assurance societies look askance at the admission of the lives of dealers in intoxicating drinks, and will seldom receive them except as hazardous.

v. *Tobacconists.*—Little can be advanced as to the vital statistics of these retail tradesmen. The study of the effects of tobacco on those occupied in its manufacture will be undertaken later on. Tobacconists are ranged among the eleven retail trades 'fairly representative of the great class of shopkeepers,' so selected by Dr. Ogle. In the order of their comparative mortality, tobacconists are exceeded only by three. The figure indicating it is 1000, whilst that of the general shopkeeper is only 865, and that of the aggregated group of eleven trades, 877. Of a total of 141 deaths, the table of causes shows that 13 were due to nervous lesions, 12 to diseases of the circulatory system, 38 to phthisis, 19 to respiratory affections, 10 to diseases of the liver, 9 to other maladies of the digestive system, and 4 to alcoholism. Thus, these returns show that 27 per cent. perish from phthisis, that 13·47 per cent. die from other diseases of the respiratory system, and that diseases of the nervous and of the circulatory system stand severally at about 9·20 per cent. The leading fact deducible is, therefore, that phthisis is unusually fatal among tobacconists. 'They suffer very much at all the younger ages,' was the conclusion of Dr. Farr.

The very extensive prevalence of phthisis among tobacconists is somewhat difficult of explanation. Their trade is pre-eminently sedentary, within doors, and entirely without bodily exercise. Most tobacconists are likewise inveterate smokers, and we cannot conceive this circumstance to be without injurious consequences to the blood-making processes,

as well as to the nervous and digestive functions and the circulatory system. Nutrition and the force of nutrition must be impaired, and the formation of healthy tissues interfered with. Their shops are frequently close, ill-ventilated, and the air laden, especially in towns, with the waste products of gas-lights, profusely used. Under such circumstances the constitution becomes sapped, and its power of reaction against cold and depressing agents correspondingly lessened.

Another particular to be noticed is, that it is a business attractive to the less robust, and to the indolent and effeminate. An occupation falling into such hands is one likely to contain an unusual ratio of feeble and consumptive lives.

Further, deaths from nervous disorders are in excess among tobacconists. This fact admits of partial explanation by reference to the conditions of their occupation above noted; it is probably, in some degree, due also to the effects of excessive smoking, and lastly, to fondness for intoxicating drinks among not a few.

ORDER B.—*Chemists and Druggists* (excluding manufacturing chemists). The retail trade, selling and dispensing drugs, has no special features; the principal incident connected with health being confinement on the premises. However, as it is a 'genteel' business and ambitious of being reckoned a profession, it will attract a certain ratio of lives of the weaker sort, which have been pronounced unfitted for occupations imposing physical toil. There are usually much standing, long hours, and but few holidays to be had. The business has a place in Dr. Ogle's table of comparative mortality of trades, and, unfortunately, it presents the undue rate of 1015, as compared with the standard —1000—for all males.

Turning to the table of causes of death, the highest numbers appear under the headings Diseases of the nervous system, 35, of the circulatory system, 19, of the respiratory, 37, of the liver, 18, and lastly, of phthisis, 48, out of 242 recorded deaths. Thus, the last-named malady figures as the cause in 19·8 per cent., respiratory diseases in 15·2, and nervous disorders in 14·4. These three series of diseases may be, therefore, looked upon as the commonest causes

of the deaths of chemists and druggists. Nevertheless the mean annual death-rate between twenty-five and sixty-five exhibits no very tangible difference from the standard for all males. On the whole subject Dr. Farr remarks (*op. cit.* p. 55), 'Chemists and druggists are younger than medical men, because pharmacy is a separate business, and is of more recent growth. Their mortality, like that of medical men, is high, and above the average, especially in the younger ages.'

Since Dr. Farr wrote, the dissimilarity in regard to age distribution in the two occupations has, of course, been lessened. In following their occupation, chemists and druggists are somewhat exposed to accidents and injuries, but, at the present day, less so than formerly; because they now receive most of their preparations, in a state ready for use, from wholesale druggists and manufacturers of chemicals. Nevertheless, they occasionally suffer by the breakage or bursting of bottles containing materials diffusing strong and poisonous vapours; and some among them are painfully affected by certain medical substances, in powder or vapour; as, for example, cantharides and ipecacuanha.

ORDER C.—*Trades concerned in the sale and production of clothing.* These are illustrated by the business of tailors, of dressmakers, and milliners; the materials used belonging to the class of textile products. Two chief divisions are at once suggested by the consideration whether the clothing is intended for males or for females; if for the former, the makers are called tailors; if for the latter, they are either dressmakers or milliners. Straw-plaiting is a somewhat allied occupation.

Though the boundary between tailors and dressmakers is usually well defined, yet the former are often called upon to make 'habits' and dresses for ladies, whilst, too, a large number of women are occupied in making male clothing, because their labour is cheaper.

Further, the making of underclothing for both sexes is the especial province of women, who get different appellations according to the special garment they produce; as, for example, stay-makers, shirt-makers, and collar- and cuff-makers. At the same time, they bear the general name of seamstresses,

and represent on the whole a more ill-paid and needy class of workers, and one of less social position in the list of trades than do dressmakers and milliners. For the question of the social position between different trades is treated by those engaged in them as seriously as that of the relative rank of courtiers; and mistakes made about rank in the former are as greatly resented as in the latter class of society.

(*a*) *Tailors.*—The trade recognises the subordinate branch of habit-making; but as this has no special sanitary features, it needs no separate notice. Tailoring formerly was purely a handicraft; not so now. Ingenious machinery is daily changing it to a manufacturing operation; and even when not performed in what can be called a factory, it is chiefly executed by sewing-machines, either in tailors' shops or in private houses.

There are undoubtedly skill and mystery to be discovered in the art of stitching and sewing, but nothing damaging to health could it be severed from indoor confinement, from fixed and more or less unhealthy postures, and, above all, from various accidental surroundings common to the occupation alike of tailors, milliners, and dressmakers. These accidental surroundings are, in some measure, the result of the inferior social status assigned to tailoring. It is a simple art, demanding no intellectual exertion and barely any physical effort, and the entrance upon it calls for slight outlay of money; *i.e.* unless it is to be carried on in a manufactory by elaborate machinery. The trade therefore is one productive of comparatively small remuneration, and as a consequence the dietary of its members is ofttimes scanty and their home-comforts deficient.

Confinement indoors,—and, when the work is done in the artisan's house, largely in wretched, insanitary, and often crowded apartments,—the cramped and unhealthy mode of sitting at work, the want of physical exercise, the frequent necessary use of artificial light, and the emission of heat in the operation of 'pressing'; in these conditions we find an array of disease-producing factors not often surpassed. To them is too often added, unhappily, the indulgence in intoxicating liquors; a failing not difficult of explanation by those who

consider the depressing and exhausting nature of their employment, and who are acquainted with shop-customs and the influence of example.

A trade with so many drawbacks—bad pay, and prolonged work standing foremost—will not prove attractive to those who have the consciousness of possessing mental and bodily endowments qualifying them for superior positions in life. Hence one reason why the tailoring trade exhibits more than the usual proportion of cripples and of ill-formed and weakly men; in other words, of individuals whose presence augments its rate of mortality and sickness, and multiplies the victims of phthisis.

We consider that the introduction of the sewing-machine, if, on the one hand, a remedy for the evil of posture, has, on the other, lowered the tailors' occupation in the economical scale, by putting it within the power of almost every man and woman possessing hands, to take up the trade without apprenticeship.

The case of the tailor sweaters, as unfolded by the inquiry made into it by a Royal Commission, has produced a deep impression upon the public. But the investigation has revealed no more than what seems well-nigh inevitable in such an occupation, open to every candidate for labour, and calling for no special skill; namely, a superabundance of labour and a consequent depreciation of wages, with the attendant evils of semi-starvation and misery in all surroundings.

In the *Sixth Report of the Medical Officer of the Privy Council*, printed in 1864, are two important papers relative to the class of workers under discussion; one by the late Dr. Edward Smith on 'The Sanitary Circumstances of Tailors in London' (p. 416), the other by Dr. William Ord on 'The Sanitary Circumstances of Dressmakers and other Needlewomen in London' (p. 362). Since these papers were written extensive changes have occurred in the circumstances of the employments reported on, particularly in the construction and ventilation of the workshops, in legislative restrictions upon crowding and overwork, and, above all, in the use of sewing machines and of machinery on a large scale in specially-built factories. The 'ready-made,' the 'slop,' and 'the Government branches' of the tailors' trade have most felt the effects

of the application of machinery; which has, on its part, very materially extended production, and improved the lot of the employed. Nevertheless, the race of middlemen and sweaters has continued to thrive, and the misery and poverty prevailing among the inferior class of workpeople, as depicted by Dr. Smith in 1863, unhappily abound at the present time in domestic places of labour, and in a lesser degree in tailors' workshops. Tailoring is not a trade for one age or sex; it gives employment to men and lads, to women and girls; and, owing to the introduction of the factory system and machines moved by steam power, it has become more than ever an employment adapted for females.

Dr. Smith, in the report quoted, enters at much length into the sanitary details of tailors' shops, and describes the home life, the diet procurable, and the wages to be earned by the tailors at that time. His general conclusions were, that 'the sanitary conditions under which tailors live are exceedingly unfavourable to health; that overcrowding, ill-ventilation, and excessive heat are especially found in shops; whilst irregularity in work and night work prevail with those who work at home.' He adds, 'the moral and social habits of tailors have much improved of late years, but excess in the use of beer is still very common, and about one-fifth or one-sixth drink ardent spirits daily.'

The preceding outline of the conditions of the tailor's trade prepares us for the results unfolded by medical and statistical research. Tailors at large are physically weak, often misshapen from long-continued and constrained positions, and anæmic, and sallow. They are also, more frequently than not, lank and lean, a phenomenon that would be oftener seen were it not for their beer-drinking habits, which develop a flabby fatness, and at times an amount of colour in the face, mistakenly looked upon as a sign of health. Their diseases are the diseases of sedentary work in bad air, of impeded thoracic movements, and of liability to taking colds, consequent on working in hot, ill-ventilated shops. Add to these causes of bad health, irregular and drunken habits, and in too many cases starvation diet, and we can well comprehend why consumption and chest diseases so largely prevail. The common ailments complained of by

tailors were, in Dr. Smith's experience, colds and sore throats, rheumatism and rheumatic pains, indigestion, headache, giddiness, constipation and piles, general debility, and inaptitude for active exercise. 'Abscess of the fingers, from pricks by the needle, were not an uncommon accident.'

Their ratio of sickness, judged from the registers of Sick Benefit Societies, does not stand on a level with that of their mortality; and, according to Mr. Ratcliffe, the amount of sickness is greater in the decenniad, from thirty to forty, than at any other period of life. The inverse state of things between the rate of mortality and that of sickness in these tradesmen prevails just as in the case of clerks. Mortality is very high, and the sickness ratio small; and for the same reason, that an amount of sickness is, in their case, compatible with work, which would be disabling to men in active and laborious occupations, and would throw them upon their club funds.

Dr. Ogle summarises his statistical conclusions respecting tailors thus:—

'The death-rates of tailors and of shoemakers have declined since the previous record in the earlier, and gone up in the later of the two age-periods. In both trades the mortality must be considered high, the comparative figure for tailors being 1051, and for shoemakers 921. . . . The chief heading under which the mortality of tailors exceeds that of shoemakers is phthisis, where the figure for tailors is 285, whilst that for shoemakers is only 254, and not very much above the average. The difference is readily explained by the closer and more confined air in which tailors habitually carry on their business. Under diseases of the respiratory organs neither tailors nor shoemakers depart widely from the average' (*op. cit.* p. 40.)

He believes that intemperance plays greater havoc with their health by reason of their indoor occupation and want of bodily exercise. These two trades show no excess of mortality from diseases of the circulatory organs; but nervous diseases abound in a higher ratio than in other trades, and among tailors more than shoemakers. Lastly Dr. Ogle considers Dr. Smith's estimate, that phthisis and chest diseases are answerable for two-thirds of the entire mortality of tailors, as beyond the truth; for his own inquiries indicate that those maladies conjoined, and when

also taken together with diseases of the organs of circulation, do not at the present day reach the high ratio spoken of.

(*b.*) *Dressmakers and Milliners, and Seamstresses or Needlewomen,* pursue a kind of work analogous to that of tailors, but with articles commonly of less dense and heavy texture, and often of more costly character. Dressmaking and millinery involve no physical effort, and, so far as concerns *Dressmaking,* most of it is now done by the aid of sewing machines. The two trades are entirely in the hands of females; to excel in them demands greater mental endowments than tailoring, in order to meet the calls of fashion, and to invent novelties; consequently dressmakers and milliners of higher position in their business need be something of artists, capable of elevating their occupation to a higher level than an ordinary manual art. This is so much the case, that our neighbours in France are not unwilling to assign a professional position to the designers and makers of fashionable female clothing, and to designate them 'artistes.' The social position accorded to the occupation, and the easy nature of the work, especially in the case of milliners, as regards bodily effort, are circumstances highly attractive to young girls of the lower middle classes, and even to many of the labouring section of the population. The girl who is apprenticed to a milliner or dressmaker becomes at once, in popular parlance, a 'young lady,' and looks down upon the domestic servant, or female worker in a factory, as a very inferior person. Hence it is that so great a redundance of female labour is found in all departments of the trades under consideration. The coupling of the idea of manual work with one of degradation has wrought, and is still working, immense mischief among young persons, both male and female. The hard realities of their position become sooner or later realised by the young women who have taken up the millinery or dressmaking business. If they escape manual labour, they are wearied by monotonous stitching, by prolonged hours of toil, by almost constant confinement to the sitting posture, with few chances for outdoor exercise and breathing fresh air. The Factory Act steps in for their sanitary well-being, by limiting the hours of work, and by endeavouring to protect them

against over-crowding in the workrooms, and to secure ventilation. But it would require something like an omnipresent organisation to see that the requirements of the Act are effectually carried out at all times; so numerous and often so inconsiderable are the shops of milliners and dressmakers. We here take no account of the multitude of places of work classified as workshops—domestic or other by the Act, where needlework is being pursued as a calling by tens of thousands of women, who rank as seamstresses—the makers of shirts and collars, and of numerous articles of haberdashery; though they have equal claim and need for Government supervision of their health conditions with milliners and dressmakers who come under it.

Another class of needlewomen exists in connection with the upholsterer's trade, busied in making textile articles of furniture, curtains, bedding, and carpets. These women, particularly those of them occupied with heavy woollen articles, such as carpets, or with the filling and emptying of beds, pillows, etc., have more arduous labour than other women using the needle, on account of the weight of the articles they work with. Besides, they are exposed to the fluffy dust of the woollen materials, and of the down and feathers employed in bedding; in a word, to well-known causes of chronic bronchitis and asthma.

Although employment in needlework is primarily a sedentary calling, the same sanitary consequences do not extend equally to all its recognised departments; inasmuch as the surrounding and accidental conditions differ materially among them. For instance, the material and physical conditions of the well-employed high-class dressmaker or milliner will be vastly different from those of the poor working shirtmaker and tailoress toiling incessantly to secure the bare necessaries of existence. Such diversities render statistics presented for the whole trade of needlewomen open to many exceptions. We need not have quoted so extreme an example of different vital conditions in operation, for the variations in such between a dressmaker of the first grade in the metropolis, and the humble caterer for the poorer classes, are sufficiently wide to produce a disturbing effect on vital statistics. The following quotations from Dr. Ord's excellent memoir on

the trade furnish ample illustrations of the differences in health conditions that prevail betwixt different departments and social grades of needlewomen, known under various trade denominations, as well as between different workshops in their sanitary provisions :—

For instance, Dr. Ord (*op. cit.* p. 362), tells us that dressmakers 'are divided into two classes : those, namely, who board and sleep in the houses of their employers, and day-workers, who live in their own homes. In the largest and most fashionable houses of business—those which are most subject to great pressure of work in the season there are few girls to be found under twenty years of age ; a fact of great importance in considering the effects of long hours of toil upon the inmates of such houses.' As might be anticipated, he found 'a wide range of difference as regards space, ventilation, lighting, and warming' in the workrooms at different establishments. Many shops were deficient in all sanitary details, the burning of gas excessive, and the ventilation of bedrooms was even more neglected than of the other apartments. His account of the state of outdoor workers is, with few exceptions, very pitiable. Those attached to shops can earn as much as fourteen shillings a week, but the average earnings are not more than nine, out of which they have to board and lodge and to dress themselves. 'In the outskirts and inferior quarters of the metropolis numerous dressmakers are found who work by twos and threes for one shilling a day and their tea, and who find even only precarious employment at this rate.'

Dr. Ord's general conclusion is, that the workpeople under consideration, undergo a slow, but well-marked physical deterioration, and suffer the usual consequences of close work in confined rooms, with no sufficient outdoor exercise. The customary disorders are headache, vertigo, dyspepsia, hysteria, and eye affections; all which prevail, as might be expected, less among the well-fed indoor hands, than among the day-workers living outside. This holds true more especially of the last-named ills, the eye-diseases, which, as Mr. W. Adams Frost informs me, are refractive disturbances, in association with hypermetropia and astigmatism.

In the other branches of the trade, Dr. Ord found shops of all dimensions, and few of them satisfactory in a sanitary sense, together with excessive hours of labour and poor earnings. But between 'the condition of persons working in wholesale houses in the City and West End, and that of

persons working in their suburban feeders and subordinate houses, is worthy of attention.' He brings forward another fact greatly deserving the consideration of statisticians, viz., the recruiting of the business in its lower grades from the failing and broken-down members of other callings, who take to working with the needle as a last resource. For this fact implies the addition of feeble lives to an overstocked and ill-paid calling, and a consequent augmentation in the ratio of sickness and mortality.

Dr. Ord wisely abstains from attempting to give the vital statistics of needle-women—that is, of females who, in one form or another, ply the needle to gain a livelihood. For, as he justly points out, there are no statistical data in existence to be relied upon; and the collection of women employed is in a state of constant change, whilst mortality returns showing employment are most unsatisfactory and ambiguous. The only expression of opinion he ventured upon was borrowed from Dr. Flintoff, the medical officer to the Dressmakers' Aid Association, that, 'in his experience, dyspepsia and phthisis were much more common among dressmakers than among domestic servants.' My own experience tends in the same direction, and indicates that anæmia, constipation, uterine disorders, phthisis, contraction of the chest with retarded and arrested physical development, and debility, are the prevailing maladies of dressmakers and needlewomen at large. And I believe that the ills attending the business are especially felt in the earlier years of employment; after which the system seems to become habituated to the conditions of work and of existence. That dyspepsia should be common is not to be wondered at; for apart from long hours and sedentary employment and poor diet, there is much tea-drinking, particularly when the hours of work are extended, for the purpose of keeping the young women awake. An amount of nervous debility, often amounting to hysteria of great severity is frequent, and attributable to the sedentary occupation and pressure of work, aggravated by the free drinking of tea, as just now mentioned, as a stimulating beverage, and, in some measure, as a substitute for proper food.

It is but right to keep in mind that the circumstances of dressmaking and dressmakers, as recorded by Dr. Ord, will

have undergone material changes—presumably wholly for the better—since the date he wrote his reports; especially by reason of the interposing salutary influence of the Factory Act, coupled with a clearer perception on the part of the public of the necessary laws of health.

The making of shirts, cuffs, and collars is become a manufacture of itself, and is done mostly by machines, and in buildings ranking as factories. The washing is performed in very wholesale fashion by special machines, and the ironing by irons often heated by a jet of gas in their interior. The ironing rooms are very hot, and labour is carried on well-nigh without cessation, though not without great exhaustion. There are many shirt-making factories in England, but in Belfast the business is prosecuted on a large scale, and I am persuaded that a diligent inquirer in that city might collect interesting statistics respecting the influence of the occupation upon the maladies, and the mortality of this special body of working women.

(*c*) *Sewing-Machines.*—An account of the health conditions of needlewomen would not be complete without a notice of those assigned to sewing-machines. In all cases where a new machine is introduced, it forthwith deranges the previous customs and operations of the business. It was so with the sewing-machine, and medical men were found among the alarmists as to its threatening damage to the health of those who used it. Its dreaded mischiefs turned out to be much less than thought for, and the ingenuity of its manufacturers has led to so many improvements in its construction, to facilitate work and to save effort, that it has made its way into most houses in the kingdom, and come to be regarded as an instrument essential to all kinds of needlework, and, for some years past, also to the trades of the upholsterer and shoemaker.

It was a comparatively recently-introduced instrument when Dr. Ord wrote, but he was able to say of it, that its influence had been for the most part beneficial to the workers. It increased remuneration, gave exercise to the muscles of the back and limbs, and lessened the degree of stooping.

Objections were made to the noise accompanying its

action as a cause of headache and giddiness, and to its use as requiring more effort to work it than a weak needle-woman could put forth without harm to herself. But such objections are of a class common to every new invention; and modern ingenuity has contrived to render its movements more easy, and to obviate its noise to a considerable degree. In large tailoring and other sewing manufactories, moreover, the toil of working the machines is done away with by the substitution of steam or gas power with the necessary couplings; and, where such power is absent, by clever arrangements, saving the necessity of constant movement by the feet or hands.

The abolition of the treddle worked by the legs, removes the objection to the instrument put forward by Vernois (*Ann. d'Hygiène,* pub. 1862, tome 8), that it caused irritation of the flexor and extensor tendons of the feet, with cramp and even incomplete paralysis. Physicians, however, are aware of the occasional production of uterine and pelvic troubles, and of nervous erethism following upon excessive employment of sewing-machines. The teaching of experience is, in short, not that sewing-machines are universally injurious to women, but that those disposed to uterine derangements, or who are of an unhealthy, nervous constitution, should not habitually use them.

(*d*) *Drapers.*—The business of drapers is, on all sides, intimately bound up with the textile trades; in fact, drapers are the dispensers of the materials produced in those trades. In large towns the division of linen and woollen drapers obtains; but in small towns and non-aristocratic neighbourhoods, the linen draper is also the seller of silk and woollen materials, of hosiery and haberdashery, and of a multitude of textile goods, including cloth, carpets, and other requisites for persons and dwellings.

The vital statistics of the occupation have been sufficiently set forth at the commencement of the chapter on retail trades, where the health phenomena of drapers is contrasted with that of grocers (p. 138). A few supplementary observations only are needed. Confinement indoors is the characteristic feature of the drapers' business. Add to this the absurd and mischievous rule, almost universally enforced in drapers'

shops, that the shopmen stand whilst attending and serving customers; to sit down ranking as a misdemeanour. Mr. Lakeman, Inspector of Factories, invented a simple contrivance, in the form of a rotating stool that could be pushed aside when not required. It obviated the difficulty of introducing chairs or ordinary stools in the narrow space left between the counter and the shelves. But simple and efficient as it is for its object, it has found small favour with the trade—a sentiment of the right position of slaves in the presence of their superiors, having seemingly survived among the rulers of the drapery business. It is not only its folly and needlessness that makes it condemnable, but much more its ill results to the health and comfort of the shopmen and shopwomen. Continuous standing for hours together is a strain especially upon the arch of the feet and the ankle-joints; a cause of weary spine and spinal curvature, favouring also pelvic fulness; and, in the female sex, productive of derangements of the uterine functions, and of uterine displacements. What makes matters worse in the case of the women is, that they are required to be dressed with some taste and in the fashion. The sex needs little prompting in this direction, and the result is the practice of tight lacing and of wearing high-heeled boots, with capacity for the feet reduced to the most 'genteel' dimensions.

Other collateral health conditions, as well of male as of female shop assistants, present themselves in the routine of their work, and in the burdensome restrictions and rules unavoidable to secure order and obedience in large establishments; and as repression implies a rebound when the pressure is removed, it is no marvel if shop-people, when released from the scene of their toil, occasionally break out into some indiscretions and irregularities. Another matter deserving notice is, that their 'places' are uncertain; they are liable to dismissal from various causes, and when out of employ are too frequently in a sad state of anxiety and distress.

It must, likewise, not be overlooked, that drapers' assistants, chiefly the men, have often heavy lifting, productive of strain and of hernia, and it is a subject worthy of inquiry, in what ratio this accident occurs among them.

The extraordinary expansion of drapers' shops into

drapery and general stores, requiring a host of assistants, male and female, for conducting business, has given rise to what may be called huge boarding establishments or barracks, for the lodging and feeding of the persons employed. In these establishments individualism is lost, and every person becomes a member of a special community, governed by minute rules, subjected to various restrictions, to the control of a rigid routine, and to a routine diet. The condition of the employed is analogous to that of a garrison, or of the pupils of a large school; and is one that must exercise special vital influences—on the whole, we apprehend, favourable to physical health, though not to intellectual development and vigour. This disciplinary existence, it is most gratifying to learn from the Factory Inspector (Report for 1881, p. 33), is made as pleasant and healthy as possible in the best drapery and millinery establishments. Sleeping accommodation is good, diet well chosen and cooked, and diversion of mind provided for by libraries, reading and music-rooms.

It must be understood that not all the hands of a large shop can be thus provided for, nor that in all shops the same advantages are enjoyed. In many small country shops neither lodging nor feeding are what they should be; and in metropolitan ones a considerable number of the assistants have to get lodgings without, though during the day they can enjoy the benefits of well-ordered meals and of cooking. The young women, if they do not find a residence in a properly organised 'Home' instituted for their reception, will by twos or threes engage a lodging together, and be thereby exposed to temptations encountered in a large city which beset an unprotected life of complete independence, and too often, as Mr. Inspector Whymper intimates, enter on a downward road.

(*e*) *Manchester Warehousemen.*—The consideration of the health conditions of drapers leads on to that of the large body,—chiefly men employed in what are known as Manchester warehouses,—so called because they are the great emporia of Manchester goods. In no material respect do these huge establishments differ from large drapers' shops.

The prevailing incidents of employment are the indoor nature of the work, with its necessary monotony and confinement; but their effects will vary according to the general sanitary state and the character of the warehouses. There appears, however, to an onlooker an advantage in favour of drapers' shopmen: for these have more variety in their dealings and a perpetual change in waiting upon numerous customers, whereas warehousemen are called upon to serve in departments appropriated to the sale of a limited series of articles, and have, so to speak, less intercourse with the world. The impression gathered is, that the occupation of the latter is most monotonous and uninteresting, and calculated to deaden the higher faculties of human beings. Besides, the management of such large commercial establishments necessitates an all-pervading routine as to hours and meals, which reduces warehousemen to the condition of passive elements in a large machine.

To a slight extent some variations in health features are to be found in the nature of the articles belonging to the several departments; in some the materials are very dusty, and in others of a somewhat disagreeable odour. And it is generally true of these huge warehouses that they are greatly crowded with goods, and the air polluted by gas.

In Dr. Ogle's table of the causes of death, drapers and Manchester warehousemen are classed together; and show conjointly a high rate of mortality from phthisis and diseases of respiration and of the nervous system; and particularly from the first-named malady.

(*f*) *Straw-plaiters* are so far makers of clothing that they weave or plait a material for making straw-hats and bonnets. Their health conditions have formed the subject of special investigations by reason of their heavy death and sickness rates, and the insanitary circumstances under which they are usually employed. The materials used play an insignificant part as health factors, and it is in the surroundings and accidental features of the trade that its injurious incidents exist. Of these, the most obvious are, that the occupation is, for the greater part, carried on in cottage homes and schools by females; that those places are unhealthy and

overcrowded; that to learn the trade and acquire the necessary manual facility to plait, children are put to it at an early age; and lastly, that the wages earned are, even when the hours of work are long, very scanty, and inadequate to secure good homes and good food.

The incidental features of the employment are sedentary work, and a cramped stooping posture. The bleaching of the straw by sulphur-fumes will cause irritation of the air-passages among those exposed to them; but this operation is done mostly by a special class of operatives, the straw-factors, —very limited in number, who by long practice and efficient arrangements usually escape very serious effects from it. Taking, therefore, the conditions of employment in this trade into consideration, diseases of malnutrition and of vitiated air are what would be anticipated. Accordingly, we find the prevalent disorders of straw-plaiters to be dyspepsia, anæmia, feeble and retarded development, scrofula, and tuberculosis; the last-named, in the form of phthisis, heading the list.

When Dr. Greenhow investigated the mortality of the straw-plaiters in the district of Berkhampstead, he found the death-rate of males to be 4·80 per 1000, as compared with 4·11, ascertained for all males in the country; and that of females 6·02 as contrasted with 4·24. This preponderating mortality of females is what would be looked for, considering that the trade is chiefly in their hands

ORDER D.—*Stationers and Booksellers.* As is well known, the business of a stationer and bookseller obliges him to lead an indoor life, and, by usage, entails a standing posture. Moreover, there are many small tradesmen who combine printing with the selling of stationery, and now and then engraving also; or, put in other words, there are men educated as printers, or as engravers, who open a stationer's shop. The really hygienic surroundings present no marked characteristics. It is a business attractive to those of less active habits, or who feel themselves disqualified for physical labour of the stronger sort, and who appreciate an occupation very devoid of stir and excitement, whilst possessing considerable interest where a literary taste exists.

The trade is enumerated in Dr. Ogle's mortality tables,

and holds a fair relative position for longevity. Between the twenty-fifth and forty-fifth years the mean annual death-rate is 8·53, and betwixt forty-five and sixty-five, 20·57; and the comparative mortality figure is 825. On comparing these numerical results with those for previous years, the death-rate indicates a satisfactory decline. The table of the causes of death shows that of 169 deaths, 51 followed phthisis, equal to 30·1 per cent.; 28 diseases of the respiratory system, or 16·5 per cent., and 23 diseases of the nervous system, or 13·6 per cent. The next in order are maladies of the circulatory system, 19 in number; then those of the urinary organs, 12. Digestive disorders account for only 2 deaths; hepatic for 4, and alcoholism for 3, of the total 169 deaths.

The lesson deducible is, that phthisis and lung diseases are rife in the business, and that disorders of the nervous system exhibit an unusually high ratio. The cause of the last-mentioned fact is not apparent; but the idea may be hazarded that it is in some degree attributable to a more highly nervous constitution among those who take up the occupation, and in some measure, to the greater mental exercise required in the bookselling trade. A word of caution is desirable respecting the preceding statistics, viz., that the numbers on which they are based are small.

ORDER E.—*Dealers in Metal Goods.* The business of the ironmonger furnishes the best example. As commonly conducted at the present day, it is a miscellaneous occupation, particularly in country towns, where the ironmonger's store is replete not only with articles in iron, copper, and tin, but also with electro-plate, oils for illuminating purposes, agricultural implements, gunpowder, etc.

It would seem that a business of this sort is devoid of insanitary conditions, excepting those flowing from confinement in the shop. Nevertheless, Mr. Neison, junior, from statistical considerations, arrived at the conclusion that dealing with metallic commodities was more unhealthy than retail trades at large. Moreover, Dr. Ogle's tables assign a somewhat higher comparative mortality figure to this business than to the group of eleven selected trades; the respective figures being 895 and 877.

The reason for this state of things is not obvious; but a suspicion will arise that the registers of mortality are in fault, and that the return of ironmongers is invalidated by the inclusion of a number of persons who have no rightful claim to the designation, and whose lives are of an inferior grade. The business does not entail a more indoor, inactive life than most other trades, nor do the articles sold possess any insanitary characters; nor is it particularly calculated to attract the weaker members of the community, nor, lastly, is it one with the reputation for the drinking habits of its followers.

ORDER F.—*Miscellaneous Retail Trades.* Besides the retail trades now described because they present special health characteristics, there are not a few others devoid of such, which call only for enumeration. All that can be said of them is, that they present the usual disadvantages to health common to all retail trades; namely, confinement on the premises, want of bodily exercise and of healthy stimulus to the mental faculties, and the frequent accessory circumstances of neglected sanitation both in shop and dwelling. As examples may be quoted, dealers in china and glass, in furniture, toys and bric-à-brac, in jewellery, clocks and watches, in prints and pictures and works of art generally.

ORDER G.—*Hairdressers and wigmakers* stand apart as a special group of tradesmen. Their occupation is unique in kind, but it has the prevailing character of being sedentary.

For some reason not at first obvious, they present a very high mortality at all ages between twenty-five and sixty-five, and a comparative mortality figure of 1051.

The occupation is unfavourable to vigorous development and muscular activity, whilst it rather favours effeminacy. Mostly in country towns, hairdressing and wigmaking are pursued by the same people; but the two branches differ in this respect, that the former requires standing, whilst the latter is for the most part carried on in a sitting position. The haircutting branch really presents no unfavourable feature, except it be wearisome standing. The dust that may attend it is little noticeable. But the wigmaking department must be characterised as a dusty one, and so must be

the antecedent operations performed by the hair merchants. The ordinary maker of artificial hair receives supplies of beautifully cleaned and prepared hair from the wholesale dealers; but he is very frequently called upon to supplement, for the sake of colour and texture, this unexceptionable material by portions of hair, the 'combings' collected from the heads of his lady customers. These combings consist of a mixture of more or less useless short hairs, with a vast amount of dust that has lodged on the head and adhered to the hair. The mass, therefore, has to be thoroughly cleaned, and the long, useful hair separated from what is useless, prior to its being made up in long tresses or bands. The chief part of this process is done by a small machine, armed on its upper surface by rows of wire teeth, over which the hair is repeatedly drawn, its action resembling that of a carding machine in a cotton factory. This operation detaches much dust, and as it is conducted by hand, and in the leaning posture, more or less dust and minute particles of hair will be inhaled. This carding process is supplemented by brushing the hair with a very long brush, to detach what dust remains. What happens with the ordinary working wigmaker, occurs on a larger scale with those who prepare hair, gathered from all parts of the world, frequently not of commendable cleanliness, and who are doubtless entered when they die as hairdressers.

Dr. Richardson refers to some observations of Dr. Cholmeley (Lecture ii. p. 132) who noticed a peculiar bronchial irritation attending the dust set up by the apparatus for hair-brushing by machinery. 'Dr. Cholmeley has known three hairdressers who have been obliged to leave their occupation' on this account. But though it be granted that this machine-brushing of the hair produces more dust than the old-fashioned hand-brushing, it does not afford an explanation of the degrees of sickness and mortality of hairdressers, for the like high ratio prevailed before machines were invented. M. Cadet Gassicourt, an old French author, found another interpretation of their high mortality in their loose habits of life, and in the predisposition to diseases of debility consequent on the effeminate nature of their employment.

The preceding account may furnish some clue to the mystery of the high mortality of the very ancient trade of the barber. The presence of dust of a peculiar form and composition, unacted upon by any fluid matter it may meet with in the respiratory passages, and therefore liable to accumulate in lung-tissue, and to be a cause of great irritation, is the most striking incident.

What befalls the wigmaker will happen to the haircutter in a lesser degree, unless his shop is kept very cleanly. And in connection with this point it has to be remembered how small, confined, and laden with the waste of gas and with the breath of customers many cutting-rooms are.

How far the statement of the French writer applies justly to English barbers we cannot judge; but this seems clear enough, that alcoholic excess and dissipation overnight would disqualify them for the operation frequently called for, of shaving their customers early the following morning, and certainly lead to their dismissal from the large shops in London and the great provincial towns. In country hamlets, however, things are different. The village barber is the depository of news; the parlour of the inn his evening rendezvous, and his company much sought after; in other words, he is greatly exposed to temptation to indulge in strong drinks, to become a sot, and so shorten his career.

Moreover, the character of the occupation recommends it for adoption by the weaker members of society; while, at the same time, it is one of small gain, especially to shopmen, and therefore unfavourable to domestic married life. They are too poor to marry; and from frequent changes in their places of employment are exposed to great wretchedness when a situation is not soon obtainable.

In fine, we can recognise a group of insanitary circumstances surrounding the trade of the hairdresser which, taken together, help to explain the facts revealed by mortality tables.

SUB-CLASS.—MECHANICAL TRADES.

This subdivision includes a group of occupations standing midway between retail trades and manufactures, and its institution has the sole merit of convenience in treating of

several employments, which it is difficult to allocate to other divisions or orders. Several of those trades already described might with justice be transferred to it; and there are others to be found in the manufacturing division which might be similarly disposed of; that such a course has not been taken arises, as above said, from considerations of convenience.

These mechanical trades admit of division into two sections, according to the nature of the material employed in them—*i.e.* whether it be inorganic or organic. The former includes the business of builders and brickmakers, and that of workers in metals, together with printers and lithographers.

The second section comprises glovemakers, curriers, shoemakers, brushmakers, carpenters, cabinet-makers, joiners, and others. The occupations enumerated as belonging to this second section are, as is at once apparent, divisible into two subsections, according as the material in use is (*a*) of animal, or (*b*) of vegetable nature.

SECTION A. *Mechanical Trades using Inorganic or Mineral Substances.* — 1. *Builders.* — Under this appellation come bricklayers, slaters, tilers, plasterers, and masons,—all using mineral substances, and all likewise partaking in a greater or less degree, the advantages of outdoor employment. They also encounter an element of danger in the use of scaffolding, and in the necessity for climbing and working at considerable elevations. Moreover, from the rough and coarse nature of the materials employed, they are subjected to lacerations and abrasions of the hands, to the production of callosities of the skin, and to injury to the eyes. Damage to the eyes follows the penetration of minute fragments of stone into the cornea, whilst the irritating qualities of lime and cement are chargeable with conjunctivitis, which, at times, extends to deeper structures, and produces ulceration and opacities of the cornea and possible blindness. The dust of lime and cement also enters the ori-nasal passages, and causes irritation of the mucous membrane; whilst the dust from cutting and smoothing stone is a very potent cause of lung disease, as hereafter illustrated in the chapter on diseases produced by the mechanical action of dust when inhaled.

The degree of exertion connected with the several

departments of the building trade varies very materially, depending as it does on the nature of the job in hand, the weight and bulk of materials used, and other particulars. A bricklayer's business cannot be called a laborious one; the weight of a brick is inconsiderable, and the chief fatigue attaches to the repetition for several hours together of the operation of laying bricks with mortar. The really heavy work is done by the labourer, who always waits upon the bricklayer. The occupation of slaters and tilers is simple, and certainly far from laborious. A slater on a roof is master of the situation, and usually proceeds accordingly with his work of fixing the slates. The tilers have even a less tiring business, having simply to hang the tiles in due order upon the roofing laths. The stone-mason has often very heavy weights to lift, and his occupation then becomes truly laborious; but the most important incident of his employment is the production and inhalation of dust, as just now referred to.

The vital statistics of the foregoing occupations are in no way remarkable. Referring to the best information as found in Dr. Ogle's tables—Builders, masons, and bricklayers, taken together, have a mean annual death-rate, between 25 and 45, of 9·25, and between 45 and 65, of 25·59; the comparative mortality figure is 969. Again, slaters and tilers have a mean annual death-rate of about 2 per 1000 living less, and a comparative mortality figure of 942. Lastly, plasterers and whitewashers exhibit a comparative mortality figure of only 896, and the smallest mean annual death-rate of the whole group—viz., 7·79 between 25 and 45. Unluckily, however, between 45 and 65 that death-rate rises to 25·07, or about the level of that of bricklayers. According to Mr. Ratcliffe, bricklayers, slaters, and plasterers have an inferior vitality of three years contrasted with the general results for all employed males in England and Wales. On the other hand, the usual rate of sickness is not experienced until middle life; though after the decenniad 50 to 60, it rises above it. According to the same statistician, stone-masons have a very inferior vitality, dying off at the age of 57 or 58, and are exceeded in this death-ratio only by clerks, potters, and letterpress printers. Their sickness rate is also excessive, being surpassed only by that of miners.

2. *Brick and Tilemaking.*—The observations on this business apply with equal force to the making of quarries, drain-pipes, and chimney-pots. The digging and raising of the clay from the pit, frequently of considerable depth, though an open working, is a laborious occupation, entailing liability to accident and great exposure to weather, with its attendant consequences to health.

Brickmaking is, for the most part, an outdoor employment requiring long endurance of physical power. Prior to the passing of the Factory Act, it was one of severe hardship to women and children, particularly during the brickmaking season when days are long. They were kept at work almost without cessation from sunrise till after sunset, taking bricks off the bench as fast as made and placing them in layers to dry. Calculations were made by industrious arithmeticians, showing how many miles were gone over, and how many tons of clay were lifted and carried by the oppressed children, put to work regardless of age and physical ability. The salutary Act named has put an end to this oppressive labour, by limiting the hours of work and the age at which employment can be entered upon. The same Act happily has put a stop to terrible immorality, resulting from the mixed employment of young girls with men and lads, by prohibiting work to girls under sixteen.

In Staffordshire, the principal seat of the manufacture of blue bricks and tiles, and quarries for paving, the processes are carried on in sheds of great length, heated by flues beneath from furnaces placed at one end. The warm floor is used for a first drying process when the article made passes from the maker's hands. These sheds have but few windows and doors and efficiently protect the men from the weather and from cold; but for the same reason they are rather close in summer.

In the making of blue bricks and tiles, particularly of the latter, there is considerable dust evolved; the labourer having to sprinkle both the bench on which he works, and the article formed, with a black dust, obtained from the sweepings of the flues and other parts of iron forges, which contain a considerable percentage of iron in the form of black oxide. The tilemaker has one or two boys to take

off as fast as he makes, and to lay the tiles in rows on the shed floor; or, in fine weather, on prepared smooth places outside. In these operations both makers and lads get covered with the black dust. Notwithstanding an extensive acquaintance with these Staffordshire blue-brick hands, I am unable to point to any marked evil results attaching to their work. They are a rough class, usually of fair development and strength, and not often sick. For the most part when illness overtakes them it is in consequence of intemperance and disorderly living.

Brickmaking by hand is passing out of date. Various machines have been invented for forming the clay into bricks ready for the kilns. These last are special constructions of a bee-hive shape, within which the bricks are arranged with great care. When blue-ware is required, the temperature of the kiln is raised to a white heat, and kept up two or three days. The only evils attaching to the kiln-work are the breathing of coal dust, and the exposure to heat, when the kiln is drawn rather hot. And the only consequence to be found among kiln or oven-men, beyond coughs, is the occurrence of local rheumatism, of lumbago, and sciatica.

Notwithstanding that tilemakers become 'black as sweeps' from the dust thrown off, they appear to suffer the effects of dust inhalation in a slight degree only; though after many years' employment, some get wheezy breathing and dyspnœa. The occupation is one that only fairly strong men can follow.

Encaustic tiles are made principally, though not exclusively, in the Staffordshire Potteries. Formerly the patterns were chiefly got by pouring a semi-fluid prepared plastic mixture, called slip, appropriately coloured, into the hollows on the surface of the yet soft clay, previously made by the impress of the moulds. Though not exploded, this process is mostly replaced by the use of coloured dusts, which are deposited on the face of the tile or quarry; the pattern to be produced being formed by metallic moulds. The dust-made tile is then rendered solid by the sudden and intense pressure of machines of like character to those used in striking coins —a screw rapidly rotated supplying the requisite mechanical

force. The tiles thus prepared are then fitted for future firing. A very considerable amount of dust is evolved in these operations; but, being dust chiefly of ordinary clay or marl, its effects on health are less marked than those of potters' clay.

3. *Artisans using Metals* are a numerous body, differing among themselves by the nature of the metal used and by the degree of bodily labour required. One attendant condition is common to almost all of them, namely, more or less exposure to heat; and in several of them to dust thrown off and productive of annoyance, if not also of disease. Differences also obtain in respect of the attitude at work, which in some of these trades is constrained and bent, and becomes a source of deformity. Again, it goes without saying, that these artisans are very liable to burns, and, when a metal volatilises by heat, to the inhalation of the noxious vapours. The last danger is met with in brass-founding and in making other metallic alloys. Moreover, in various operations with metals mineral acids are used, and when this happens decomposition ensues with the evolution of irritating gaseous vapours. Last, but not least, the quality of the metal used, whether poisonous or not, or whether rendered so by chemical action upon it, plays its part in the hygiene of the metal trades.

(*a*) *Occupations wherein Iron is the Metal Used—Blacksmiths.*—Their occupation is a distinct one, and dates back to a remote antiquity. The hygienic conditions of the trade are few and not important, and, besides, are well understood. The typical blacksmith is a brawny, well-developed man, who illustrates in his muscles the effect of active use in producing hypertrophy. As a trade involving strong muscular efforts, and much fatigue in standing, it is one avoided by the less robust, and hence, by this principle of selection, the physique of its followers is maintained. And usually, if a weak sapling intrudes himself into the occupation, necessity compels him to give it up sooner or later, or else he breaks down from over-wrought powers, the heart being the principal sufferer.

Blacksmiths are exposed often to great heat, and to burns

from flying scales of iron when hammering. The margins of the eyelids also very frequently become reddened and inflamed, and the conjunctiva injected. The weight of the tools produces not only expansion of the hands and increased development of the thumbs, but also hardening and callosities of the palms. The strong action of the arms likewise develops the muscles of the arms and thorax.

The heavy work and the lifting of weights are predisposing causes of hernia and of aneurism. And as their labour is conducted in more or less open and draughty shops, and causes them to dispense with all superfluous clothing, blacksmiths are somewhat unduly liable to pneumonia, acute bronchitis, and rheumatism, acute and chronic.

Another occasional incident of the blacksmith's craft, due especially to working with hammers for a long period, or with heavy ones,—as sledge-hammers,—for a shorter length of time, is the production of the so-called 'Hammermen's or Hephæstic palsy,' and, at times, spasm of the arms, though this is not restricted to them. It is a form of paralysis arising from over-use and over-strain, analogous to that witnessed in the fingers and hands of scriveners, pianists, and other people who subject those parts to over-exertion. Moreover, as might be supposed, hammermen's paralysis is not peculiar to blacksmiths, but occurs with other workmen who wield hammers or heavy implements to excess, or use lighter ones too continuously. (See hereafter Chapter on Over-use and Over-strain.)

The occupation of a blacksmith must, on the whole, be pronounced a healthy one; nevertheless, in comparative statistical tables, it holds an inferior position to that of engine-makers and fitters and mill-wrights. Its mean annual mortality is, between twenty-five and forty-five, 9·29; a higher rate than that of most other mechanical trades in which the materials in use are innocuous; this may be attributed to the exhausting effects of the labour upon those of less mature age. This same fact is conveyed by the statement of Mr. Ratcliffe, that the specific vital intensity is highest at the age of eighteen, and on and after that period gradually decreases until the end of life. Their expectation of life follows the same rule. On the other hand, the aggregate of

sickness among them, from twenty to sixty, is more than 4 per cent. less than the general aggregate for the same period (*op. cit.* p. 43). A glance at Dr. Ogle's table of the causes of death indicates that phthisis and diseases of the respiratory organs—represented respectively by 194 and 183, out of a total of 872 deaths—are the leading causes of mortality among the artisans in question; and that after these maladies come those of the circulatory system, numbering 108; and next in order nervous maladies, 85.

In commenting upon the disorders of blacksmiths, the prevailing intemperate habits of these workmen must be noted. Bearing this fact in mind, we are prepared to learn that of the 872 deaths, 39 were due to urinary diseases, 28 to liver lesions, 7 to alcoholism, and 31 to 'other diseases of the digestive system.' Lastly, the proportion of fatal accidents,—143 in number,—exceed what might be expected.

(*b*) *Other Occupations Employing Iron.*—There are many other occupations allied to the primitive one of the blacksmith, who, in olden time, was, in fact, the general craftsman in iron; but the work of the blacksmith of the present day is divided among a host of artisans, bearing different appellations, according to the character of the article they manufacture. Thus, we find as special occupations, the making of nails of various sorts and sizes, of nuts and bolts, of screws, of edge tools, locks, stoves and boilers, and of a multitude of other articles constituting the stock of the ironmonger's shop. The trades quoted are exclusive of those of Sheffield,—the making of cutlery, of files and saws, of needles and fish-hooks, of guns and steel-pens. In short, the simple trades of olden days are now in constant course of subdivision, with the result that novel occupations bearing new designations almost yearly emerge. Of the many employments of this class, it is necessary to make a selection of such as present the more marked hygienic characters. Others will be noticed as subordinate branches of manufacturing processes, hereafter to be described.

It is a singular phenomenon that the manufacture of each particular class of hardware has become centred in a small area, or in a few towns; the chief determining influences

being cheapness of fuel, accessibility to the raw material, the gradual development of a body of skilled craftsmen and abundance of labour. Thus it is that the nail and chain trade has been located in Halesowen, Cradley Heath, Dudley, and other places thereabout. In these localities coal abounds, iron is procurable close at hand, and labour in plenty is to be found among the wives and daughters of the colliers.

1. *Nail and Chainmakers* follow occupations which are really identical with the business of the blacksmith, but have become detached therefrom because of the advantages arising from division of labour. Their occupation is, unfortunately, a decaying one, owing to the introduction of machinery to effect the same ends; whence an unequal struggle is carried on for existence; with the attendant results of wretchedly-paid labour, penury and misery, and recourse to female and child labour for the sake of cheapness, without regard to the question of physical and social fitness for the work. The passing of the factory laws has arrested the employment of very young children, of old resorted to regardless of their strength; but the law is impotent to infuse fresh life into the trade and restore its prosperity.

There are many kinds of nails in use, some of which demand much more physical exertion in their manufacture than do others. But the main operations are forging and hammering on anvils; and if the poor artisan is to earn a bare sustenance, he or she must work without intermission during the legalised hours, and also with great speed and dexterity. The dimensions required regulate the thickness of the iron rod to be cut and presently beaten into nails, and consequently also the labour involved. Not only are the hands and arms in constant exertion, but pressure with the foot is needed besides, to set free a suspended hammer by whose stroke the head of the nail is formed. When larger nails are made, the work falls partially, if not wholly, upon adult males. For example, making spike nails is the business commonly of a man and girl, or of a man and boy. The first operation is that of cutting the half-inch thick rod of iron whilst cold into proper lengths. This task is very

severe, and effected by an instrument called an 'oliver,'—a heavy sledge-hammer, worked by two or three men by means of a treddle, on which they jump together with all their force. The same sort of rude apparatus is used in the subsequent forging of the nail; the girl simultaneously working vigorously with the hammer on the anvil, and the sledge or 'oliver' with her foot. This laborious work is totally unfit for women; and demands to be made illegal. It is, moreover, unnecessary, for machines are constructed to cut through bars of iron with the greatest facility and without human exertion. That such machines are not in use in the nail-making trade is to be explained by the circumstance that this trade is carried on by a multitude of poor labourers, without capital to invest in machinery, and that their labour is productive of very slender profit.

In chain-making, girls and women are replaced by boys and men, excepting for small chains. The boy's business is chiefly to work the bellows whilst the man does the forging with hammer and anvil, aided by the 'oliver' when welding the links.

The manufacture of chain cables is merely a heavier variety of smiths' work, requiring great strength and activity, and more mechanical appliances. The earnings are large, and the taste for beer correspondingly great. Sufficient has been said to prove that the occupation of nail and chain making is, in most of its details, one of excessive labour, particularly so for women; and what adds to its disadvantages is, that the wages to be earned are miserable, and made still more so by the sweating system. Nevertheless, there is no clear evidence that these artisans suffer seriously in health from the conditions they work under. To settle this point, statistical data are needed to prove the average duration of life, the amount of sickness, and the ratio of mortality and its causes. Nailers get contraction of the palmar fascia, and after a while lose power over the fingers; they likewise acquire in course of time very decided curvature of the spine, with great elevation of the right shoulder above the left. This deformity prevails to a greater extent when work is begun at an early age.

The hygienic circumstances of the nail and chain trade

are rendered so much the worse by its being carried on in small wretched shops or hovels, and often by the various members of the family owning them; a condition of things that renders sanitary control almost impossible, and the provisions of the Factory Act all but nugatory. Notwithstanding the cheapness of production, the occupation cannot survive long against the competition of machine-cut nails.

2. *Locksmiths.*—The work of *locksmiths* does not make so great demands upon the muscular strength as does that of nailers and blacksmiths. The lockmaker stands continuously at his 'vice,' to fit and shape the several portions of the lock, and is, as Dr. Harthill of Willenhall kindly informs me, a sufferer from varicose veins and ulcers of the lower extremities. Locksmiths, who work on an 'addle' or shaky anvil, or with hammers having unsound handles, suffer from vibration or jar in hammering, a speedy cause of great pain in the wrists, which often extends to the shoulder, and of a grating sensation along the tendons of the forearm. The injury may lay them up for two or three weeks; but no permanent damage is done.

Keys and other small articles in iron and brass are stamped out of the metal when brought to a red heat. This proceeding is now mostly done by powerful stamping machines. Formerly, after the heated metal was placed on the 'die,' a heavy weight was drawn up several feet above it by means of a pulley worked by the strength of several men, and suddenly let fall on the article to be stamped. This operation was repeated two or more times, as might be necessary. The men concerned in it seized a chain or rope by both hands, and whilst firmly steadying themselves by one foot on the ground, placed the other in a loop or stirrup formed on the rope, pressing downwards and backwards with all their might. These workmen were known as 'kickers,' and the violence of their labour was the frequent cause of hernia. This method of stamping exposed them to other accidents, such as severe burns and lacerations from portions of the metal driven off with violence. Where machines are in use, pressure, though very forcible, is applied less suddenly and at the same time more equally; whence there is less dispersion of heated

particles than with the old simple but rude proceeding, and fewer individuals are exposed to accident.

An associated occupation to the making of small iron ware is that known as 'bobbing,' which consists in sharpening tools and brightening articles on grindstones, and bears a general resemblance to the work of Sheffield grinders; it partakes also in the same evils to health, by the dust evolved.

As in nail, so likewise in lockmaking, competition and a remarkable division of labour have so cheapened production that no satisfactory profits or wages are to be got. And the entire condition of the artisans therefrom, physically and morally, is aggravated by the multiplicity of small masters and small shops, to the hindrance of sanitation.

In the volume on *The Industrial Classes and Industrial Statistics*, by G. Phillips Bevan, 1875, the following peculiar health incident is described (p. 78):—'Children are occupied in blowing bellows, filing locks, and drilling the pipes of keys. There is nothing necessarily unhealthy in this employment, except that the metal has to be placed in a vice, which is usually too high for the children to work at, except by standing on some pedestal. This constrained attitude (and doubtless the long hours of work prevalent in those days) was shown by Mr. Horne to lead to displacement of the right shoulder-blade, and the bending of the right leg inwards towards the knee. At the same time it is satisfactory to learn that locksmiths are far above nailers, and indeed above many of the Black Country operatives in physical and moral improvement.'

Nut- and Bolt-making has in the past been, for the most part, carried on by small masters. For entrance on the business called for very small capital, and, like nail-making, it suffered terribly by competition, with the result of small profit to masters, and of heavy labour to their men, with meagre wages. The same circumstances encouraged resort to juvenile labour, and stood in the way of sanitary improvements and of amending the general condition of the operatives at large, whilst, on the other hand, they created an impoverished population and ready victims to disease.

At the present time, ingenious machinery has been introduced, and we may consider the days of the manual manufacture of bolts and nuts to be numbered; for neither cheap

labour nor unmitigated toil can overtake the rate and cheapness of production, and the accuracy of form attainable by the machines.

3. *Civil Engineering.*—In the manufacture of machinery, in the work of the civil engineer, and in the various processes included under the term 'fitting,' the skill of inventors has devised engines to accomplish almost every operation required, human aid being only auxiliary. Every day witnesses the increase of automatic machines of one kind and another, which dispense with the active co-operation of workmen.

The operations carried on in an engineering establishment are very various; differing widely in the demand they make upon muscular strength and upon manual skill, and also in the amount of heat and dust attending their performance. In the best-organised establishments, lifts, travelling cranes, sawing, drilling, and planing machines, and many others, are moved by steam power or by electricity, and accomplish what formerly had to be done by muscular force with the aid of simple levers, blocks, and the like. The consequence is that there is but a fraction of the wear and tear of the human frame that formerly attended engineering work, and the relation of the artisan to many machines is little else than that of a minder, regulating speed and power, and watching and measuring results.

A caution to be learnt from these observations is, that in analysing statistical tables of the mortality and sickness of engineers, we are dealing with a very mixed body of workmen, of unlike health conditions, and more or fewer of whom bear the name of engineers because they work in an engineering establishment, though unskilled in the technicalities of the business.

The occupation exposes the workmen to many accidents. Machinery is often ponderous, and from this cause a source of injury. Other machinery is extremely rapid in its movements, and a careless artisan is often a victim to it. But most accidents are due to recklessness, and especially to the frequent absurd practice of shifting straps on revolving wheels and of oiling parts whilst the machinery is in motion.

Those divisions of the occupation to which ill results to

health are attributable belong, for the most part, to the finishing departments concerned in filing, grinding, and glazing, particularly when the metal wrought is brass or copper. In engineering works where they cast their own brass, the brass-founders suffer from the fumes of the metal, as described further on in this volume. Likewise the brass-turners and polishers are subject to the ill-effects of the components of the brass, and are usually thin, sallow, and dyspeptic. Lastly, the evils of the dust from grinding and polishing powders beset the artisans who 'glaze,' or polish on wheels dressed with those powders;—among which are the red oxide of iron, emery, pumice, and rotten stone; nor is red lead a stranger in the shops.

4. *Iron Casting* owes its chief risks to exposure, heat, and to the explosion of molten metal; but the making of moulds and cores preparatory to casting, is dusty work. These articles are constructed of sand and charcoal or fine ash, prepared beforehand for the moulders by grinding and sifting. To avoid explosions when the molten metal is run in, great care is required to obviate the presence of too much moisture, and also to provide apertures for the free escape of the steam generated. When the casting is completed and turned out of the mould, it requires careful cleaning and scouring to rid it of the dust, and when this is effected it passes to the turners and polishers, who give it the necessary smoothness and polish. This account makes it evident that metal casting and polishing ranks as a dust-producing business.

The making of hollow ironware, kettles, saucepans, and the like, is done by casting. The shops or sheds in which this business is conducted are well open to the air, with the advantage of allowing dust dispersion and the escape of heat. Within an enclosed shop both the dust and heat would be considerable, where an active trade is going forward, on account of the many furnaces to supply the molten metal, and the presence, at and about the working place of each artisan, of the ware in different stages of cooling—the actual process of casting being done on the floor of the shed near by the working bench.

These unhygienic circumstances suggest the production

of rheumatism, of colds and inflammations, chiefly of the thoracic viscera, and of the consequences of dust inhalation. The men employed look, for the most part, fairly vigorous, but somewhat pallid, and they are fully cognisant of their liability to the diseases just mentioned, and of the usual brevity of their lives. Report suggests that the last-named incident is not wholly a result of the trade, but is greatly abetted by the common habit of intemperance. The diffusion of dust is unmistakably evidenced by its lodgment on the skin and clothes of the men. Hollow-ware, after being annealed, has to be turned on a lathe to prepare its inner surface for tinning; in this operation, again, another source of metallic dust is encountered, from which a heavy mortality arises.

Like so many other trades in which manual labour has been replaced by machinery, that of casting promises to shortly undergo the like transformation; for a newly patented process for applying hydraulic power has been brought forward, which undertakes to dispense largely with the long-established body of casters, and to effect the work hitherto done by them more efficiently and with vastly increased rapidity.

5. *Boilermaking* has, for its peculiar hygienic conditions, heavy labour and great noise; the latter arising from the process of inserting the rivets or bolts required to unite the several component plates together. There is, besides, much risk of burns from the red-hot rivets. To rivet the bolts, the plan has been to place lads within the boilers to steady the rivets by counter pressure, whilst the workman hammered them on the outside. To everybody near at hand riveting is a most noisy operation, but to the unfortunate boy within it is a hundredfold more so. The most marked result of the boiler-maker's trade is the production of deafness. The skill of the inventor has stepped in and contrived a machine for driving and clenching the bolts: dispensing with the presence of boys inside, and obviating much of the noise and dangers heretofore associated with the business. Likewise, the former manual operations of drilling, punching, and shearing boiler plates are now accomplished by powerful engines.

Statistics of Workers in Iron.—From the public mortality returns, Dr. Ogle has calculated the mean annual death-

rates, and the comparative mortality figure of (1) locksmiths, taken together with bellhangers and gasfitters; (2) of engine and machine makers, fitters, and millwrights; and (3) of boilermakers. The outcome is, that the second group occupies the most favourable position, though not a high one, contrasted with other trades,—its mean mortality figure being 863. The figure for the first group is 967, and for the boilermakers, 994. These numerical results present but a rough approximative notion concerning the vital statistics of the trades in question. The first group is heterogeneous,—for the work of locksmiths is very different from that of bell-hangers and gasfitters; and its collective statistics point to no reliable indication of the connection between the occupations brought together and their mortality. The second collection presents more uniform conditions of occupation; still, in the general uniformity, there is great diversity. Speaking of millwrights, Mr. Ratcliffe says their expectation of life equals that of the general class of lives at every decenniad, and their aggregate sickness is less.

Boilermakers have the highest comparative mortality figure among the trades named, and their mean annual death-rate is greater at all ages between twenty-five and sixty-five; but gunsmiths show still more unfavourable statistics, their mortality figure being 1031.

In this account of trades concerned in manufacturing articles of iron, we have given no place to the cutlery and needle manufactures, because by far their most important sanitary relations are connected with the production of dust, of which a full account is hereafter given.

(*c*) *Occupations in which other Metals than Iron are used in Mechanical Trades.*—The metals in common use in such trades are tin, copper, zinc, lead, gold, silver, aluminium, platinum, and mercury, together with various alloys, such as brass, bronze, German silver, Britannia metal, nickel silver, and pewter.

Such of these as possess poisonous properties will be better examined in the section devoted to occupations in which poisonous materials are used. When these are withdrawn, those remaining are metals that exert no very marked

effects upon workmen who employ them in the arts. This is true of tin and zinc, the working of which is the especial business of *whitesmiths*. Copper and brass are metals worked by coppersmiths, braziers, and engineers, and belong to the category of poisonous materials. Platinum, nickel, and aluminium may be regarded as innocuous; and, omitting alloys, there remain only silver and gold, as used in mechanical trades, to be examined. And the little that can be said about these metals will be best included in the remarks on jewellers and watchmakers.

§ 1.—*Watch and Clock Making.*—The retail sale of watches and clocks has no health aspects of its own. Most dealers, however, have a practical knowledge of construction, and undertake repairs; and, so far as this goes, stand on the same footing as makers.

The common characteristic of the occupation is its very sedentary nature, coupled with a stooping attitude to approximate the eyes to the object in hand. Good eyesight is an essential qualification for the workman, inasmuch as the mechanical operations to be performed are mostly on a very small scale, and need the greatest nicety. To aid vision a magnifying glass is placed to one eye, and there held by the contraction of the orbital muscles; a circumstance which, in time, affects the expression of the face. The employment further demands close and steady attention, and a certain measure of mental strain; and to obtain sufficient illumination, a strong light, from a gas or other lamp, is required.

It would be very opposed to fact to suppose a watchmaker to be the constructor of a watch in all its parts. Certainly, there is one division of the trade in which the artisan puts together the sundry parts of a watch and finishes it for sale; but his business is the complement of a score and more callings; each separate component portion of the mechanism being the product of a distinct art or craft, having some peculiarity of its own with regard to the requirement it makes on the skill, attention, and vision of the worker. Watchmakers follow their business for many years, and often show less failing sight than many people engaged in ordinary

occupations requiring no great efforts of vision. Their work is almost always performed by one eye, aided by a strong magnifier, the other eye remaining at rest. Dr. Bell Taylor suggests that this mode of working may account for the absence of disturbance of accommodation, and expresses his full concurrence with the opinion, above stated, that eye derangements are rare among watchmakers. I can point to the best confirmatory evidence on this point, kindly supplied me by Mr. Russell, of Liverpool, whose intimate acquaintance with the trade is unquestionable. He writes to me that, among the many hands he employs, he has met with no instance of incapacity for work attributable to their employment, and that it is exceedingly rare to see a watchmaker wearing spectacles. 'My experience' (he adds) 'in this respect covers a large ground and a long period, as at one time or another I have visited most of the large watch manufactories in England, Switzerland, France, and the United States.' The sedentary nature of the employment, and the leaning position when at work, will account for feeble muscular development, for narrow chests, for dyspepsia, anæmia, and other their well-known consequences. Referring to his knowledge of Coventry, where the greatest number of English watchmakers reside, Mr. Russell (in the letter already quoted) says that the reports from the Dispensary there, and other sources of information, indicate that the prevailing complaints are indigestion, lung affections, and enlargement of the liver; and, on the other hand, that optical complications are very few.

Further, as experience proves, some exaggerated mobility of the nervous system results from the nervous and cerebral strain involved by the minuteness and delicacy of the work and the individuality inseparable from it.

Layet says there is a special (professional) malady, consequent on the inhalation of particles of brass and copper by the manufacturing watchmakers, who file and polish the works or 'movements' of watches, or ornament by engraving and skilful 'turning' the surface of the watch-cases. The consequence of this inhalation is, according to him, a form of consumption. Perron's observations, in the watchmaking city of Besançon, led him to put the medium mortality from

phthisis at fourteen in 100 deaths. But as with making jewellery, accidental circumstances in watchmaking play a more important part in producing disease than do its incidental details. The same practice is pursued in the two trades, of putting out work for execution to domestic workshops, where sanitary laws are but seldom observed.

One accidental condition of their work deserves mention, viz., that they will work in highly-heated shops,—a circumstance in part explained by the necessity of having sufficiently warm hands to enable them to accomplish their delicate manipulations. This circumstance diminishes their robustness, and renders them more liable to taking cold; the frequency of catarrhal and chest maladies among them bearing witness to this fact.

Watch and clock makers present, in Dr. Ogle's mortality tables, a mean annual death-rate of 9·26 between the twenty-fifth and forty-fifth, and of 22·64 between the forty-fifth and the sixty-fifth years, and a comparative mortality figure of 903. Watch and clock, philosophical instrument-makers, and jewellers—taken as a group—exhibit a higher scale; a fact, perhaps, accounted for by the inclusion of the two latter trades. For jewellers, as presently pointed out, labour under several disadvantages from which the watch and clock makers are free; and as to philosophical instrument-makers, it is the misfortune of some among them to have to handle metallic mercury, and occasionally to suffer therefrom.

The conclusion follows, that watchmakers have a rate of mortality less than that of most sedentary occupations; and, to refer again to Mr. Russell's experience, they generally have good lives. In his factory are found many old men whose fathers and grandfathers were watchmakers before them.

§ 2. *Jewellers and Workers in Gold.*—Mere dealers in jewellery incur no liability to sickness or to a high mortality, except so far as confinement to their shops and insanitary surroundings concur to produce it. On the other hand, some special health conditions are connected with the manufacture of jewellery—of gold, silver, and precious stones. The incidental conditions are close, very sedentary work, and with it a bent attitude whilst sitting, close application

of the eyes, much artificial light, heat from furnaces, crucibles and the blow-pipe, and acid fumes. The working with precious stones entails the minutest attention and observation, together with strong visual exertion, and most delicate manipulation with the fingers and forceps or other tools in use. The lapidary's wheel is a source of dust from the polishing powders used—for the most part rouge, emery, and diamond dust; and as we learn from Proust (*Ann. d'Hygiène Publique*, 1878) it is likewise a cause of lead-poisoning when a lead cylindrical rod is used for polishing cameos. In this proceeding the cameo is held against the revolving rod, and from time to time moistened with a mixture of tripoli powder and vinegar; whence arises a dust consisting of acetate of lead.

Nitric acid is largely employed for dipping and to brighten the surface of jewellery; and where many persons are employed in the same shop, and that not well ventilated, there is enough nitrous acid vapour given off to become a source of throat, chest, and stomach irritation. The frequent contact of the acid also with the skin provokes sores, eczematous eruptions, and cutaneous fissures, besides doing injury to the nutrition of the nails. The leaning position of jewellers over their work aggravates all the other unhealthy incidents of their occupation.

The evils of dust production attend the makers of polished steel ornaments in a much higher degree than lapidaries, by reason of the larger quantity of polishing material needed, and the constant use of brushes.

As long as gilding of jewellery was carried on by the water-gilding process, those employed in the art suffered in the same way as others engaged in that process, from mercurial poisoning. This serious ill is avoided where electroplating is substituted. There, indeed, are gases evolved from this operation, but not to an extent sufficient visibly to affect health, though those unused to electroplating are conscious of a peculiar odour of a somewhat irritating kind. I am here speaking of the galvanic process as applied on a small scale to jewellery; when it is employed in a large way, observers are agreed that the gases—hydrogen and others—evolved, exert an unhealthy influence. Another disadvantage of

electroplating exists in the use of cyanide of potassium in the solution for plating, as elsewhere noted.

Stamping by machines, mostly hand-worked, has replaced the process of beating out patterns by hammering, and thereby given an enormous impetus to the jewellers' business by the increased cheapness of production attained. The stamping presses are chiefly worked by young people. They are constructed on the same principle as presses for coinage, being worked by a screw, which drives down with immense force the piece of flat metal,—the blank or disc, upon the steel die. The work being done with great rapidity, needs long practice altogether to avoid injury to the fingers employed to place the disc under the screw and to remove it after the stroke. Want of practice and carelessness are fruitful of mutilated fingers.

The sedentary character of jewellers' work, its confinement, and the bent position long sustained, the abundance of artificial lighting, and the heat proceeding from constantly burning gas-lights, and gas-jets used for blow-pipes to melt solder and heat soldering-irons, the waste burnt of gases, the acid vapours, the dust from polishing stones and settings, and other lesser evils, represent a series of health conditions suggestive of the production of phthisis, bronchitis, anæmia, and general debility with digestive troubles—an inference borne out by statistics. The encouraging aspect of the matter is, that the ills enumerated are, for the most part, remediable by sanitary arrangements, foremost among which are ample working space and effective ventilation. For the unfavourable conditions of the jewellers' art are almost all of accidental character. There are factories—happily increasing in number—built and arranged according to sanitary principles; but to a considerable extent, the making of jewellery is put out by the masters among men and women occupying domestic workshops, of which by far the greater part are unfit places of work, and situated in densely-inhabited localities. Division of labour leads to facility of execution, and thus it happens that one artisan, by special application to this or that department, gains great superiority, and renders it worth while to employers to distribute work among several such 'specialists.' For instance, one man has

the reputation for chain-making, another for bracelets, a third for stamping jewellery. It is sad to state that the recognised unhealthiness of the occupation is in no small degree due to the folly of the working jewellers. It operates as a misfortune to many of them that they can earn money too easily, and that they spend it to their detriment in self-indulgence.

As a very small capital is necessary to start with, there is a large number of small masters, of whom many have been working men. This circumstance leads to much competition, and keeps down prices, and, at the same time, encourages the growth of domestic workshops where sanitary provisions are more or less at fault.

The proportion of females occupied in the trade is not large. Their work is chiefly directed to making silver ornaments and chains, and to producing the cardboard boxes for the finished articles.

The handling of metallic silver and gold is not attended by any harm to health. With the many salts of these metals possessing poisonous and caustic properties, we have no present concern.

In gilding pottery a liquid gold is employed, as well as specially prepared gold in a solid form, but easily reduced to powder; but gilders exhibit no symptoms of disease other than those fairly assignable to very sedentary work. I have noticed a black line along the edge of the gums in many who have worked at gilding for a long time; but with respect to this feature, it is right to remember that more or less quicksilver is added to the gold, and sometimes other metals; and that it, therefore, is difficult to say that the gold is the cause of the phenomenon mentioned.

§ 3. *Diamond and Gem Cutting and Polishing.*—This very limited occupation is chargeable with the production of dust, and has attracted the attention of writers upon industrial diseases. It is one specially pursued in Holland, where several memoirs on its consequences have been produced. Moreover, both Hirt and Merkel devote an article to it. From our own observation of diamond cutting and polishing, we can scarcely imagine any definite morbid result from the dust of the gem. It is far too precious to

fritter away into dust by any coarse grinding likely to give off a tangible quantity of its substance; and we suspect that the recorded ill-health of diamond workers is chiefly attributable to accidental circumstances connected with the charcoal furnaces formerly used; to overheated and badly-ventilated shops, and to dissipated habits among the employed. So far as diamond dust may possibly be thrown off in the polishing process, so far, doubtless, would it be an irritant to the respiratory organs by reason of the very sharp and angular character of its atoms. The above remarks hold good concerning other precious and ornamental stones, of which no special account is needed.

Layet propounds it as a fact that diamond cutters and polishers, and the makers of jewellery also, suffer largely from eye diseases; among which he mentions as most frequent congestion of the choroid, asthenopia, cataract, and chronic ciliary blepharitis. This list of ophthalmic troubles among jewellers, it struck me, was one of an *à priori* character; intimating what might be expected rather than declaring what is the case; and this suspicion was strengthened by what I had learnt concerning the allied occupation of watchmakers. I accordingly addressed inquiries to Mr. Lloyd-Owen, the senior surgeon of the Eye Hospital at Birmingham, in which city the making of jewellery is centred, and with it fine metal work, engraving, gem setting, and diamond cutting. To convey the result of his experience, I cannot do better than quote the letter he most kindly sent me. He speaks in the name of himself and of his colleagues thus:—'The cases of eye affection which present themselves to us from these trades as suffering in connection with their work, are those in which some optical defect exists, and more especially the refractive errors—hypermetropia and astigmatism. Youths apprenticed to these trades, being the subjects of optical defects, suffer from asthenopia and hyperæmia of the choroid, retina and conjunctiva, and with blepharitis. But in their case it is not the work, but the unfitness of the eyes for the work, which is to blame. I do not agree with Layet as to the effects of these trades. This is the experience, too, of my colleagues at the Birmingham Eye Hospital, with an average of over 20,000 cases (not attendances) per annum. There is

also a large watch-making trade in and near Birmingham—Coventry especially—and some of the work is exceptionally minute, but it is not productive of mischief to normal eyes.' He sums up by saying, 'On the whole, I should say that fine work, even when regular and persistent, does but little, if any, harm to normal eyes.'

The manipulation and adjustment of minute parts in watch-making, and in setting jewellery, occasionally induces spasms of the flexors of the fingers, which may advance to contracture.

§ 4. *Printers and Lithographers* may be accounted as operatives engaged in a mechanical trade, employing inorganic material; though with equal propriety they might, as working with paper, be classed with artisans employing vegetable material. It is enough to find a convenient place for introducing an account of their occupation and its incidents. Engravers on metal, stone, and glass will be best examined in connection with this section.

The very high rate of mortality of printers has often arrested public attention, and has called forth special investigations. Under the direction of Sir John Simon, then Medical Officer of the Privy Council, the late Dr. Edward Smith conducted, in 1863, a lengthened inquiry into 'the Sanitary Circumstances of Printers in London,' and the results appeared in an Appendix to the *Sixth Report* (p. 383 *et seq.*). In prosecuting his inquiries he visited printing offices connected with each division of the trade, and both newspaper and jobbing offices, and examined the health conditions of 'readers,' compositors, press and machine-men, and boys and warehousemen. His painstaking report showed that in almost every printer's shop there was a most lamentable absence of sanitation. The shops or offices were, for the most part, ill-fitted for the work done in them, of insufficient cubic capacity, destitute of efficient ventilation, and with an atmosphere charged with the combustion products of an enormous gas supply, and with the respiratory exhalations of the people at work. These insanitary surroundings were rendered so much the more injurious by prolonged hours and night work, and by careless and intemperate habits on

the part of the men. The state of things differed somewhat according to the department of work pursued. Readers and compositors suffered in health more than machinemen; whilst in the case of lithographic printers an additional cause of sickness arose from certain poisonous colours used in their art.

Of compositors, as a class, Dr. Smith says:—'By far the great majority are thin and pale, with large pupils,' but they happily looked upon themselves as generally healthy, and had little to complain of as to appetite. He adds, 'As a whole, I could not arrive at any other conclusion, from general observation, that they were a sensitive and not a robust race, enjoying life in only a moderate degree, and not peculiarly liable to varied and acute diseases, but with a tendency to defective alimentation and assimilation, and thence towards exhaustion of body and consumption.' Further, 'The nature of the employment leads to abnormal conditions of the eyes, such as congestion, inflammation, short sight, and blindness; but, with the exception of short sight, none came prominently under my observation. It is also commonly believed that the conditions of the employment lead to habits of drinking, and it is universally admitted that snuff-taking is the besetting sin of the compositor.'

Another circumstance noted by Patissier, is the liability to cut fingers in handling new type, particularly when copper-faced. The resultant wounds are severe, and the idea prevails that particles of metal get introduced and act as poison. Moreover, many compositors acquire the foolish habit of placing type in their mouth,—known as 'chewing type.' That the dust which accumulates by friction of the type in the 'cases,' and in other ways, may be a cause of injury is readily conceivable, inasmuch as its chemical analysis made for Dr. Smith showed that, in 100 parts, there were 9·44 of lead, 1·81 of copper; 1·00 of antimony, and a trace of arsenic.

Poisoned hands and dropping of the wrists do, as Dr. Smith was convinced, occur; but are uncommon when the number of compositors at work is taken into account. 'The great foe of the printer is consumption and other forms of chest disease, with a state of low vitality and deficient alimentation of the body, almost certainly leading thereto; and it may not be doubted that the whole excess over that

of the general community is due to the unhealthy conditions in which he is placed, and to causes quite preventible' (p. 403). These statements apply to the whole craft of printers, and not to compositors only.

The work of compositors involves no muscular exertion, excepting that required, from time to time, to remove the 'forms,' which may be of considerable weight, when the type set up is large. Otherwise the position of a compositor at work is almost wholly standing—a circumstance accountable for varicose veins, ulcers, and swelling of ankles.

Dr. Smith sought to determine the relative amount of sickness prevailing by an analysis of the records of their benefit clubs, but he found them inadequate to his object. However, they furnished him with data regarding the mortality of compositors. Having first calculated that the duration of life of these artisans is less than that of other members of the general community, he proceeded to contrast the records of a sick society, composed of compositors only, with those of one admitting all the other operatives in the same establishment, and worked out as the result 'that the mortality among the compositors was 60 per cent. greater than among the other classes' (p. 404). Thackrah, in his brief notes, says:—'We can scarcely find, or hear of any compositor above the age of fifty.' And Dr. Ogle's table of mean annual death-rates per 1000 living, shows those of printers, between twenty-five and forty-five, to be 11·12; and between forty-five and sixty-five, 26·60; and that the comparative mortality figure is 1071. These vital statistics are confirmatory of the foregoing statements.

The official contribution by Dr. E. Smith to the health history of printers deserves the use we have made of it, by its thoroughness and accuracy; but the lapse of nearly thirty years will necessarily have exerted a modifying effect upon the picture given; and happily one marked by improvement in all particulars. In the first place, the health conditions of printers and their workshops have been vastly amended by the provisions of the Factory Act, under which they are placed. These provisions carefully regulate the duration of employment, the distribution of night work, and the age at which employment may be entered upon. The restrictions,

however, do not apply directly to adult men, in accordance with the broad general principle of the Act, nevertheless, rules are laid down for securing ventilation and cubic space, and likewise for the general salubrity and cleanliness of the work-rooms.

The enforcement of these conditions, coupled with the improved recognition on the part of the public at large of the laws of sanitary science, has led to the gradual replacement of the unfit buildings Dr. Smith had to deplore, by suitably constructed premises; and has put a check upon night work and irregular work, especially for youths, who were, when that physician wrote, sad sufferers. It is consequently interesting to learn from Dr. Ogle that the mortality ratio of printers has been considerably reduced, although still very high, and demanding yet further efforts to remove its well-known principal causes. By the kindness of Mr. Drummond, Secretary of the London Society of Compositors, I am able to present the causes of death of 799 compositors who died in the course of the ten years from 1880 to 1889, inclusive. The teaching conveyed confirms the conclusion arrived at by Dr. Edward Smith, Dr. W. Ogle, and others, as to the heavy mortality of these artisans from consumption:—

Of the 799 deaths—

Phthisis was the cause in . . .	296
Bronchitis and asthma, . . .	85
Pneumonia and pleurisy, . . .	67
Paralysis and apoplexy, . . .	61
Heart-disease, ...	56
Cerebro-spinal disease, . . .	33
Bright's disease, ...	21
Gastro-intestinal, ...	19
Hepatic disease, ...	16
Senile decay, ...	34

Accidents were accountable for 14, epilepsy for 6, general paralysis with insanity for only 5, and cancer for 8. Miscellaneous indefinite causes numbered 27, including 15 under the headings of syncope, exhaustion, debility and asthenia, and others under vague terms, besides a few of a surgical character.

Calculation of the percentage of the leading causes, proves phthsis to have produced 37·03 per cent. of the deaths; bronchitis, 10·63;

pneumonia, 8·38; paralysis and apoplexy, 7·63; heart-disease, 7·00; and senile decay, 4·35. Respecting the last-named cause, 20 survived to be between 70 and 80 years of age, and 13 to between 80 and 90,—1 reaching the advanced age of 88. One death referred to as from senile decay was only 68, and therefore doubtfully belóngs to this category. Reviewing the ages arrived at, it is found that

between	20	and	30,	110	of the	799	died
"	30	"	40,	180		"	"
"	40	"	50,	158		"	"
"	50	"	60,	129		"	"
"	60	"	70,	116		"	"
"	70	"	80,	82		"	"
"	80	"	90,	24		"	"

Thus, considerably more (48) than one-half died at ages between 20 and 50.

The average yearly number of members during the ten years has been 6348. Year by year there has been a progressive increase of membership averaging 285.

On examining the ages at which phthisis carried off its victims, we cannot escape the conclusion that this disease is the prevailing cause of the high mortality the table above shows to obtain between 30 and 40, and 40 and 50. Moreover, that the ill-effects of the occupation declare themselves most decidedly after work has been carried on for a series of years, and less so in the first decade of manhood.

The ages at which consumption proved fatal are as follows:—

From	20	to	30,	73	deaths.
"	30	"	40,	111	"
"	40	"	50,	71	"
"	50	"	60,	34	"

and as many as 7 cases are reported where consumption proved fatal above the age of 60.

It is well deserving notice that, in the foregoing list of diseases destructive of the lives of compositors, no mention occurs of plumbism; and that, again, the proportion of paralytic cases by no means arrests the attention, as it might be expected to do, were Hirt correct in attributing an appreciable proportion of the high mortality found to prevail to plumbism. It was the special subject of Dr. Whitley's

investigations, to be found in the *Sixth Report of the Medical Officer of the Privy Council* (p. 354), to inquire into this matter of lead-poisoning among compositors; and his conclusions agree precisely with those obtained by Dr. Edward Smith and Dr. W. Ogle, viz., that cases of plumbism are very rare, and that when they do happen they arise from the insane habit of 'chewing type,' from negligence of cleanliness of person and in work, particularly when the type 'cases,' more or less charged with dust from the wear and tear of type, are emptied and cleaned. My own inquiries and observations on this subject are completely confirmatory of these views. Nevertheless, it seems to be true that, in bygone years lead-poisoning was much more common among compositors; and Dr. Whitley quotes Mr. Adlard's (the well-known printer of Bartholomew Close) remark as affording a partial explanation of the fact, viz., that formerly, type was distributed in a wet state, and afterwards dried before open fires; hence the workmen handled it in a moist and warm state; whereas at the present time it is distributed in the dry state. For the sake of comparative statistics, Dr. Ogle's account of the mortality of compositors may be adduced. He writes:—'It is entirely due to phthisis, their mortality figure under this heading being no less than 461, against an average of 220 for all males; that is to say, the mortality of printers from this cause is more than twice as high as the average;' and no occupation approaches that of printers, in regard to mortality from consumption, excepting that of costermongers and of workers in mineral dust.

The table of fatal diseases above produced does not lend its sanction to the inference drawn by Dr. Smith as to the frequency of rheumatic gout, to explain which he referred to the custom of indulging in London porter and stout. However, we must remember that the table is constructed from mortality returns, and therefore cannot be trusted to represent the relative prevalence of disease. For illustration, rheumatic gout may not be the immediate cause of death, although a long-lasting sickness. So with regard to rheumatism, also referred to by the same writer as common; together with affections of the eyes and brain.

One evil of printing-houses would be removed by the

substitution of the electric light for coal gas. This substitution has indeed been essayed, but unfortunately the electric light cast such deep shadows about the work and workmen as to interfere with the operations of printing. Still, we doubt not that this difficulty will be overcome.

Among the ills besetting compositors, Layet enumerates weakening of the sight, defects of accommodation, chronic inflammation and blepharitis, which he accounts for by the strain of eyes in composing, and especially the glare of artificial light. Van Holsbeck believed in a tendency to cerebral congestions and hæmorrhage from the prolonged mental attention, and also in the occasional onset of spasm and inco-ordination of the fingers from excessive use in their minute work, and at a later period tremor. Other reported disasters of their occupation are neuralgic pains, deep fissures of the lips, and at times the development of tumours on their inner aspect, seemingly the consequences of 'type chewing.' Respecting eye troubles, my own observation does not bear out Layet's statement as to their frequency.

The process of stereotyping has been in use for many years, but has of late received an enormous development, particularly in connection with newspaper printing, so that now the copies of periodicals are printed from stereotyped plates instead of moveable type set up in 'forms.' One drawback to this improved process is, that it subjects the workmen employed in the stereotyping shop to the handling of the metallic alloy used,—rich in lead, and also to its fumes when melted preparatory to taking the castings. Inquiry I made showed that these operatives are liable to plumbism, and particularly the man or men engaged at the furnace in melting the alloy and ladling it out.

When Dr. Smith wrote, the 'pressmen' formed a large class, engaged in working the simpler printing-presses of that day, a business that called forth considerable bodily strength, especially of the arms. They were more healthy and vigorous than compositors, but their places of employment were, for the most part, very unfavourable hygienically, the machines being placed usually in the badly lighted and ventilated basement of the printing offices, and too frequently in contiguity with the boilers.

Constant standing, with greater or less strain on the legs, was the predominating feature of their employment, and thence came varicose veins and sore legs; whilst, as a consequence of strong pulling, hernia, as the elder writers tell us, was an occasional evil. As a matter of course, there are pressmen still, but their old mode of working has been superseded by the wonderful development of the modern printing machine, whereby the pressman has become little else than an attendant upon it; and we see the marvellous machine in newspaper offices strike off, fold, and count the sheets by thousands in an hour. Bodily strength is consequently at a discount, and the disadvantages of the occupation limited to the heat of the press-room—caused principally by the heated cylinders of the press, and to a greater or smaller extent, where coal-gas and not electricity is used for lighting, by the gas jets. Add to these the noise of the machines, the standing posture, and confinement in the press-room and sustained attention to their work, and there remains nothing else calculated to injure the pressman's health, barring circumstances within his own control.

Lithographers.—Closely connected with the business of engravers is that of lithographers, and its subdivisions, found in the art of producing chromo-lithographs and oleographs. These occupations present no very obvious sanitary features, although in relation to art they are of very high interest and importance. They occupy a middle position, in regard to technical details, between artists and printers, and the only circumstance, apart from the hygienic state of their workshops and the necessary confinement within doors, that suggests itself as a cause of occasional sickness, is the employment of poisonous colours.

§ 5. *Engravers* may be spoken of in this place in the absence of a better, and by reason of the connection between their business and that of printers.

(*a*) *Copper and Steel Engravers.*—The health characteristics of the trade of engravers on copper and steel are alike few and of no great importance, except those belonging

to it as a sedentary occupation, demanding a fixed and a stooping posture. Accessory conditions are the frequent use of strong light, and severe taxing of the sight, often by very fine work, and the employment of strong acids.

As is well known, engravers practise their art chiefly on wood and metals; but there is one form of their business in which they work on stone, and resort to an etching process. Whichever be the material employed, the causes of ill-health to be found in it are few and slight. When acids—almost always nitric acid, and often the red fuming acid—are used on metal to etch out the pattern or picture, there is an evolution of irritating gas, but neither in quantity nor in duration likely to cause more than temporary annoyance by irritation and congestion of the respiratory passages, and damage to the teeth. The most obvious possible cause of bodily harm exists in the close application of the eyes; but even as to this matter, experience indicates that it is followed by no sensible result where the normal eyesight is strong and healthy. From our own knowledge of many engravers, and inquiries made amongst them, the occupation may be pursued for a long series of years without detriment to vision, and without necessitating the help of spectacles. As with watchmakers, it is one eye, aided by a special magnifying glass, that is most exercised; the other eye remaining at rest. This statement as to the general immunity of engravers from eye affections does not fully accord with the views of Thackrah and Layet, who refer to them as liable to such affections. It is a problem for statisticians to settle.

There are several branches of the trade, ranging from that of the highest class of art engraving to that of producing the simplest outlines and letters, not varying among themselves in essential features, but only in the amount of art feeling and fine manipulation demanded. But if, on the one hand, the eyesight can undergo the great strain required without damage, it does, on the other, grow in acuteness and distinctness, while the employment develops an augmented nervous sensibility of the whole frame, which makes its impress upon the entire individual. Moreover, the cultivation of visual power proceeds *pari passu* with that of sensibility of touch. As a matter of course, these effects are

generally in a direct ratio with the degree of artistic taste and skill required by the description of engraving practised.

Among lesser bodily evils, engravers become round-shouldered from continued stooping, and suffer with callosities of the thumb and forefingers from friction and pressure of the graving tools; now and then they have contracture of the little finger from its habitual curved position and pressure on the plate engraved, and a semiluxation of the thumb backwards from the use of the graving tools. Moreover, as happens in all occupations from overuse, the fingers are liable to spasm. Layet adds anæsthesia of the skin of the hands and forearms; a tendency to semi-curvature of the fingers of the right hand, and atrophy of the interosseous muscles.

The vital statistics of engravers constitute a problem to which no writer as yet appears to have devoted himself. Layet says that engravers suffer above the average of artisans from phthisis, but he gives no figures. It is a fact which may well be looked for in the presence of the more or less unhealthy conditions and surroundings of the engraver's occupation; but as it is a comparatively limited trade in point of numbers, there will be so much the greater difficulty in collecting a sufficient series of facts to justify statistical conclusions.

(*b*) *Engraving on Glass and China* has only a general affinity to engraving on metal and wood. The former art is done either by diamond points and emery wheels, or, more or less completely, by etching with hydrofluoric acid. Engraving on china is effected by the same acid, which bites in a pattern, by dissolving the silica along the lines previously traced in a varnish covering the surface. Few persons are engaged in either of these two forms of employment.

Hydrofluoric acid being highly corrosive softens and inflames the skin, and in the liquid state produces ugly ulcers. The vapour also inflames and irritates the eyes and mucous membrane of the nose, pharynx, and larynx, and hence causes coryza and cough; and, according to my own observation, denudes the tongue of epithelium, renders the gums swollen and spongy, causes painful indigestion, general malaise and debility, and acute dyspepsia, with acid

eructations and sour, fetid breath. In a word, it is detrimental to the health of the whole system. On account of its poisonous and corrosive properties, its use is very limited.

Patterns, moreover, are produced on glass by the 'sand blast,' which bites into those portions of the surface which are unprotected by some kind of varnish by its mechanical action. Were it not that this process is conducted within an enclosed space, it would prove injurious by the dispersion of dust.

SECTION B. *Mechanical Trades using Materials of Organic Origin.*—The organic world supplies a host of substances which man, by his ingenuity, has converted to his use, as well by simple mechanical as by truly manufacturing operations. At present we have to deal only with mechanical trades. In proceeding to do so, it is at once apparent that we must distinguish organic materials according as they are derived from the animal or from the vegetable world. Trades employing the former are represented by furriers, glovers, shoemakers, saddlers, curriers, and brushmakers; whilst those using the latter are illustrated by carpenters, cabinetmakers, joiners, chairmakers, and others. In the case of many employments belonging to each division, their vital conditions are such that they best find a place, on etiological grounds, under one or other of the manufacturing processes hereafter to be described. For instance, the business of pearl button-making is a simple mechanical one; but as the production of dust is its chief health feature, it seems better placed among occupations specially partaking of that characteristic. So, again, there are many small trades which, although primarily objectionable to health on account of the effluvia attending them, seem best grouped among employments of which offensive emanations constitute the chief evil recognised.

Conversion of Iron into Steel.—This proceeding takes place either on the new principle represented by the 'converters,' invented by Bessemer and Siemens, or by the old process of carbonising the iron. The former method is noticed in the chapter on Heat as a source of disease in

manufacture; the latter is briefly described in this place, as its chief unhygienic characteristic is the generation of dust from the charcoal employed.

Dr. Greenhow examined the occupation in connection with the amount of chest affections prevailing among those engaged in it, who are locally called 'converters.' He says of them:—'They are liable to inhale the dust of charcoal while placing it in alternate layers with iron bars in the converting furnaces; the same men, after the conclusion of the process, draw the steel from the furnaces, during which they are much exposed to inhale dust and carbonic acid gas, and also frequently to a highly-heated atmosphere. To prevent themselves from inhaling dust during the latter process, converters are accustomed to cover the mouth and nose with a wet sponge. These men are liable to oppression of the chest and dyspnœa if they continue long at the employment, which few men, it is said, can follow for more than eight or nine years; and most of them turn to other departments of labour as soon as they begin to feel injured by their occupation. A man who had worked for seven years as a converter, in one of the principal factories of this kind, said he had worked longer than any one else in the place' (*Report* iii. p. 125).

SUB-SECTION *a.—Occupations wherein Animal Substances are employed.*—Of such glove and shoemaking, the making of saddles and harness, and the work of curriers and furriers, furnish examples.

Glovemaking has no serious incidental health factors. It is not, so far as the majority of male workers are concerned, in strict sense a sedentary business, for several kinds of work call for active movements of the arms and trunk, and the standing position. But in the case of the women engaged in the finishing branches the sitting posture is the rule. The skins used by glovers are received from the skin-dressers in a dry parchment-like condition, and besprinkled with a fair amount of dust (see hereafter notes on skin-dressing). In sorting the skins before delivery to the glovemakers, considerable dust, of an irritating character, is thrown off. By a succeeding operation, called 'frizzing,' effected by drawing and stretching

the skin over a steel edge, the stiffness is removed. This done, the next process is to reduce the thickness by a kind of shaving process, and to trim its rough and irregular edges. To reduce thickness the skin is stretched on a marble or metal slab, and being dusted with flour, is shaved on its under or flesh side by a broad chisel-like implement. Whilst thus engaged, the workman frequently blows away the soft fibrous trimmings with his mouth, and from time to time resprinkles the surface with flour. Large coarser skins are stretched on a sort of wooden shield, 'the beam,' and worked with a two-handled tool, which the workman draws towards him. This proceeding creates a risk of severe wounds above the knee, should the leather tear. The operation is called 'doling,' and is admitted by the men engaged in it to be unhealthy; causing tightness and weight at the sternum, and after some years' employment, chronic bronchitis and asthma.

The late Sir Charles Hastings published, in 1820, a book *On Inflammation of the Mucous Membrane of the Lungs*, and recited his experience among the glovemakers and leather-dressers of Worcester, where he resided. His remarks apply primarily to 'preparers of yellow leather,' and point to a more serious form of bronchitis than is encountered at the present day, attended by great dyspnœa, enormous expectoration, frequent hæmoptysis, and, at length, hectic and wasting.

That these direr consequences of the leather-workers' employment have become events of the past, may be attributed to greater care and cleanliness, and, above all, to the abolition of domestic labour and the erection of spacious, ventilated shops in factories. The processes succeeding 'doling' are of a harmless character; consisting in imparting a polish by means of heating the outer surface and rubbing with a woollen rubber; in cutting and shaping the gloves, and finally in stitching them. This last operation, in modern factories, is done by sewing machines, moved by steam-power, and which require no treddles, and therefore no help on the part of the women and girls using them, except to start and stop their action. There is a minor cause of dust in the use of finely powdered French chalk which is sprinkled on the

inside of the finished gloves, to facilitate wearers putting them on. This task is delegated to women. Its influence on health it would be difficult to estimate; but I cannot conceive it to be of any serious moment, because the quantity thrown off is small and quickly dissipated where shops are well ventilated. Another reason for this opinion rests on the fact that this cretaceous powder possesses very slight irritant effects upon the respiratory passages. Lastly, it is known that some skins or felts imported for leather-making are dressed with arsenic; I am not aware if this happens with skins introduced for glovemaking. It is, however, a circumstance to be borne in mind in any future researches into the hygiene of glovers.

Dr. Greenhow included glovemaking in his report 'On districts with excessive mortality from lung disease,' and pursued his investigations at Yeovil, a special seat of the industry. Since 1861, when his report was printed, a vast change has occurred in the conditions of labour; chiefly in the springing up of factories and a great reduction in the extent of work done in the homes of the people, in the extension of the factory laws which regulate the hours and age of labour and other matters, and in the introduction of sewing machines. This being the case, it seems unnecessary to quote Dr. Greenhow's observations, which now but partially apply to the occupation. However, this much may be stated, that his researches connected the high death-rate of Yeovil glovemakers with the sedentary character of their work; with the early employment of children (at seven years old frequently), with work done in poor, wretched, insanitary homes, with miserable earnings, with long hours of labour, and with social and moral degradation inseparable from such conditions.

In 1864 Dr. Edward Smith's inquiry into the conditions of nourishment of the poorer labouring classes was published in the *Sixth Report of the Medical Officer of the Privy Council.* In this paper, again, the health of glove stitchers came under notice; and Dr. Smith insists on the evil effects of sitting and leaning forward to do minute work, especially in the dim light which a poor home alone furnished. 'Hence (he writes) contraction of the chest, displacement of the lungs backward, deficient respiration, and impaired eyesight

commonly follow' (p. 225). Since this was written stitching machines have come into use, with much resultant benefit.

The latest notice of the trade that I have met with is in the 'Report of the Chief Inspector of Factories, 1888,' from which it appears that in kid glovemaking, owing to foreign competition, most stitching is still done at the cottage homes, though by the aid of machines the workers are enabled to get greater earnings than could be obtained by the old plan of hand-stitching; and therewith improved homes and diet. The male workers, however, have not, it seems, lost their long-standing love of strong drink (pp. 64-5).

Fur Cape-making from the skins of goats, rabbits, hares, and other lesser mammalia, is a very limited business, chiefly pursued in London; and to a great extent in the hands of Jews; which is as much as to say it is one pursued with little regard to cleanliness, and with very meagre rewards to the poor women engaged in it. Not having witnessed the mysteries of the business, I trust to the account given by Mr. Inspector Lakeman, who presented a long and interesting account of the various manufactures of the metropolis, in the *Annual Report of the Chief Inspector of Factories*, issued in 1887. He there writes:—'In the manufacture of rabbit skins into capes we meet with insanitation, misery, and dirt. . . . A workshop has a bench whereon the cutter shapes the skins; a large coke fire dries wet skins, which are stretched on a board before it; the smell from the dye is disagreeable, and the fluff from the skins irritating; the walls and ceilings are covered with dirt, the floor is strewn with fragments of fur, and heaps of the same are piled up in available corners. . . . The skins are received in the rough and sewed into capes, the lining and finishing being done elsewhere. Subdivided labour is seen here as in every East End industry; the occupier (a Jewess) is a cutter, one man is a cutter, another a stretcher, another a nailer, women are sewers' (p. 99).

The poverty and misery of the employed is illustrated by the fact that the business is only active for six months of the year, and that work when continued for twelve hours a day does not realise more than five or six shillings a week.

3. *Shoemaking.*—In the circumstances prevailing less than half a century ago, there was much to write about respecting the business of boot and shoemakers in its relation to health. The greater portion of the work was then done by the solitary shoemaker, or by a few collected in a small shop; and the whole operation was a simple handicraft. At the present time the old-fashioned craftsman is rapidly disappearing under the influence of factories, often of large dimensions, fitted with machinery which requires little else than the guiding hand, and turns out boots and shoes in as few minutes as the best workmen in olden time took hours to accomplish. This rapid production is greatly aided by the subdivision of labour, one workman being occupied with a machine which cuts out almost instantaneously the 'uppers,' or the 'soles,' of the shoes and boots. Another presides over the machine which stitches the uppers, or 'closes' them; another attaches the soles to the uppers. This last operation is called 'making,' and is much harder work than closing, especially where heavy boots are made. In former times the shoemaker was instructed to perform each of these operations, and to turn out a shoe or a boot complete. Such skilful handicraftsmen will ere long be no more found. They cannot compete with machinery. In the olden time the shoemaker sat with his last held firmly between his thighs and knees, and to 'close' used a simple instrument,—the clamp,—to keep approximated the edges to be sewed together. He sat on a low stool, with the trunk bent forward considerably, the last pressing against his breast-bone and stomach. With his awl he drilled holes to pass his waxed thread through, using his arms forcibly to fasten each stitch. To fix the sole on the uppers the drilling and stitching demanded vigorous pulling by an outward movement of the arms from the chest, not unfavourable to chest expansion. But the advantages of this expansile movement were negatived by the pressure of the last against the chest, which, when practised from early years, caused a marked depression of the breast-bone and cartilaginous ends of the ribs, in outline like the hollow of a spoon. This pressure was, at the same time, detrimental to the stomach, and a cause of dyspepsia. The long sitting had as its sequel

obstinate constipation, doubtless aggravated by neglect of the workmen. With dyspepsia and constipation went piles, and the whole series of troubles prevailed, in a very high proportion of these tradesmen, and were commonly aggravated by indulgence in strong drinks. As a class, too, the common shoemakers were neither clean nor tidy in their habits and persons, and the calling was looked down upon as one of low social grade; a fitting employment to which to apprentice the boy inmates of workhouses.

In the modern style of bootmaking the uppers are riveted to the soles, instead of being stitched. Where 'making' is done at home by hand, the chest suffers from pressure against it of the heel of the boot,—fixed on an iron last, in the operation of burnishing and filing off the rough ends. Those who cut out and shape the leather to be made up are called 'clickers;' and these pursue their work standing in a stooping attitude, and to some extent press the stomach against the work bench.

For the finishing operation upright lasts have been introduced, at which the men can stand; but many prefer, as of old, sitting, with more or less pressure of the last against the thorax.

According to Dr. Farr's calculations, issued fifteen years ago:—'Shoemakers at all ages, except twenty to twenty-five, and at advanced ages, experience a rate of mortality below the average, whereas tailors die at rates much above the average' (*op. cit.* p. 56). When Dr. Ogle wrote, ten years subsequently, the death-rates in these two occupations had declined, but still the rate of tailors exceeded that of shoemakers—the respective mortality figure being 1051 and 921. The excess was chiefly due to the greater prevalence of phthisis among tailors, the mortality from which was 285, as compared with 254 for shoemakers. Tailors had also the undesirable pre-eminence in deaths from alcoholism.

Mr. Ratcliffe speaks equally favourably of the comparative value of the lives of shoemakers, stating that they stand third in the table of highest vitality, being exceeded only by agricultural labourers and carpenters. At the age twenty to thirty the rate of sickness among them is in excess, but from thirty to sixty it is below the average. Mr. Thackrah,

after noting the unhealthy pressure of the last upon the stomach and liver, says that lads put to shoemaking often suffer so much from headache and indisposition, that they are obliged to give up the business. And, he adds, 'digestion and circulation are so much impaired, that the countenance would mark a shoemaker almost as well as a tailor' (*op. cit.* p. 30); a countenance that may be described as commonly expressive of deficient nutrition, of more or less bloodlessness, of imperfect depuration of the blood, and of impeded hepatic functions.

The truth of these observations was very demonstrable in the case of shoemakers when Mr. Thackrah wrote; but I believe the phenomena generally were far more attributable to the accidental circumstances of the business, than to the incidental; more to the insanitary shops, dirt, and irregular living, than to any peculiarities of trade processes. Nevertheless, even at the present period, the bulk of shoemakers have a meagre, unhealthy look (though working in capacious factories and rescued by machinery from what were unhealthy mechanical operations), due, principally, to the fact that many of them still pursue the evil example of their forefathers, in addiction to strong drinks, besides many irregularities damaging to health.

Several of the older writers affirm the liability of shoemakers to heart and lung affections, and Hannover, from his Copenhagen hospital returns, calculated that one-third who followed the trade in that city died from phthisis. Referring to Dr. Ogle's tables, we find that of 1635 deaths from all causes, 451 were due to phthisis, which equals 27·5 per cent.; certainly an excessively high ratio.

Shoemakers working on the old system exhibited trade signs in their hands, among which are enumerated expanded hands, flattening of the forefinger and thumb at their distal end, a fissure or depression where the index finger was cut by pulling the thread in sewing, and a posterior semiluxation of the left thumb.

The vital statistics of shoemakers, as above quoted, apply, to a great extent, to past years, when the old trade operations were in vogue. It will be interesting to learn what

changes for the better the adoption of machines and the extension of the factory system to the trade have wrought in the health history of shoemakers. The new system has evidently numerous advantages, but these may, in some degree perhaps, be lessened by the circumstances of associated labour, and of heated and over-lighted workrooms,—particularly where hot pipes exist, and a superabundant supply of gas is consumed.

The transformation of the shoemaking business from the position of a small trade to that of a manufacture would have justified its inclusion in the section of manufacturing operations. But, after all, its processes are really of a simple character, consisting in cutting out to shape, and stitching or riveting portions of material together, agreeing in most particulars with those of dressmaking (leather taking the place of textile fabrics), and presenting no very diverse hygienic conditions; the primary one of sedentary labour prevailing in both.

Saddlers and Harnessmakers.—The makers of horse-clothing and accoutrements perform much of their work in the sitting posture and within doors. Considerable muscular exertion is required in its execution. Beyond these conditions it presents no others obviously injurious to health, nevertheless their death-rate is higher than that of the class of shopkeepers generally; the mean for the saddlers, between twenty-five and forty-five being 9·19, and between forty-five and sixty-five, 26·49; whereas the corresponding figures for shopkeepers are, 9·04 and 21·90. So, in like manner, the comparative mortality figure for the former is 987, and that for the latter 877. Another circumstance is deducible from Dr. Ogle's table, namely, that the vital statistics of these tradesmen show of late years an increased value of life; a fact that may possibly justify the inference that the younger race of saddlers is physically a better one—perhaps so by reason of improvement in the matter of temperance, for which their predecessors in the trade were not celebrated.

The work of cutting out leather to the pattern required, and that of stitching two or more layers together, is a business of considerable labour for the arms. Moreover,

tradesmen who do much cutting and shaping lean forward and to one side, throwing more weight on one leg than on the other, to the damage of bodily symmetry.

Curriers.—The business of the currier is one of simple mechanical work, and is for the most part pursued in conjunction with that of tanning and leather-dressing. The operation consists almost entirely of strong rubbing of the leather on a table with a wooden tool, whereby the 'grain' is raised; at the same time a grease is rubbed in until it penetrates the substance at all points. When a black colour is required, lamp-black mixed with oil and size is employed. Other colours are got by various chemical compounds, some of which probably are not quite innocent. Nevertheless, the work of the currier may be pronounced free from any distinct injury to health. It entails active movement of the arms, and a constant bending forward of the trunk in the act of rubbing.

In the business of leather-dressing and colouring, where a red colour is required, orpiment is sometimes mixed with lime in the vats, with the attendant danger of arsenical poisoning. Again, in the varnish or enamel for dress shoes lead is a constituent, and consequently a possible source of plumbism to those who apply it on the leather, as well as to those who prepare it.

Combmaking.—This industry is of a limited character, and at the present day carried on in small factories which have superseded domestic workshops. The material chiefly used is of animal origin, in the shape of horn, tortoiseshell, bone, or ivory, and in modern days vulcanite. The same substances are applied to the production of various other articles besides combs; to wit, buttons and studs, paper-knives, and sundry other small wares.

The operations concerned in making these several articles are simple, and require no elaborate machinery. Those suggestive of ill results to health are chiefly sawing and turning. The maceration of horns in water to open them out, and their subsequent flattening by superimposed pressure, are operations devoid of injury to health; but the next

proceeding, that of cutting them into laminæ by means of circular saws, is productive of a large quantity of dust. Polishing is free from this evil, as it is done by heat and pressure. Tortoiseshell is dealt with in a similar fashion, but requires, as a preliminary process, boiling for some time in water to which salt is added. Both horn and tortoiseshell can be cast in moulds by the aid of heat, after first being reduced to powder.

The dust in a comb-factory, although visible in a cloud, seems almost harmless, its animal quality redeeming it from action as an irritant to the pulmonary tissue. Still it is quite conceivable that Hirt may be correct in considering it a cause of bronchitis. Further remarks on horn dust occur in the chapter on the Pathology of Dust.

Hatters.—The hat-making trade has within the last half century undergone great changes, owing to altered fashions and to material modifications in the manufacturing processes, and above all, to the beneficial operation of the factory laws by reducing the hours of labour. The old beaver hat is almost a thing of the past; and its supplanter, the silk hat, is in its turn threatened with gradual extinction by the increasing use of felt head-coverings. There is a great similarity in the construction of a beaver hat and of a silk hat. Instead of the hairy beavers' skin, a prepared silk fabric made in France is substituted. This is fixed by size upon the framework, built up of layers of cotton cloth stiffened by shellac dissolved in spirits or naphtha, and shaped upon a mould or block. In the construction of beaver hats a larger proportion of spirits of wine is used.

In this branch of the trade no very serious causes of ill-health are perceptible. The silk covering comes ready prepared, and consequently the English silk hat-makers are saved from the fine floating particles of silk and fluff set free in its preparation.

A considerable degree of heat attends the processes of blocking and ironing, and there is free evaporation of the spirit or naphtha used in the stiffening resinous solution. The naphtha at times provokes skin erythema and eruption,

and the vapour of the methylated spirit is apt to produce conjunctival congestion and lacrymation, with pain and heaviness of the head; and in some cases coryza. But after allowing for the influence of these incidents of the trade, we feel strongly that the ills discoverable in the business are mainly due to unhealthy workshops, over-crowding, and indulgence in alcoholic fluids.

The making of felt hats is a more complicated proceeding, and forms the subject of a chapter in the second portion of this work, describing manufactures characterised by the heat and steam that accompany them.

Brushmaking owes what sanitary evils it posesses to the bristles, and to the horse or other hair employed. These materials, as imported from most foreign countries, are in a very unclean state, and consequently require to be cleansed by boiling in water to which soap and some alkali are added. After this operation they are beaten, combed and sorted. The act of boiling is attended by nauseous odours, and the liquor remaining is very offensive, and full of decomposing organic matter, in consequence of which it should not be turned into any stream or stagnant water. Beating and combing give rise to considerable dust of a highly irritant, and as experience has proved, sometimes of a contagious character. These primary and preparatory processes are performed by a special class of workmen, who deliver the bristles or other material to the brushmakers, made up into small tresses or bundles. These, however, are not in the precise condition requisite; some dust yet remains in them, and short hairs have to be got rid of. This end is effected by drawing successively the whole contents of the bundle in small portions through a kind of comb with strong, but distantly set teeth. A small amount of dust and waste are thereby removed, but the former does not exceed what may often be seen on sweeping a well-kept living-room.

The next proceeding consists in taking up the bristles necessary to make a tuft or pencil of the required size, and to pass it through the ready drilled holes of the stock or framework of the brush, made of wood, bone, ivory, or other material, fixing it firmly by a coil of thin wire; or else, as in

the case of larger and coarser articles of domestic use, by Norway pitch, into which the narrow end of the tuft is dipped before insertion.

The fastening of the tufts by wire has no injurious effect, excepting in thickening and hardening the skin of the fingers employed, and at times lacerating it. The fixing by pitch is also a healthy operation; the only disadvantage being the heat and smoke arising from that substance kept in a liquid state in a small caldron placed in front of the workmen; for, happily, the fumes of pitch, if slightly irritating to the respiratory passages, possess no evil qualities.

When fixed, the surface of the brush has to be cut by strong scissors or shears to produce a flat or level convex surface. This operation sets free a small amount of dust, rendered more considerable when, as practised in France, the workman, in order to get a better grip with his scissors, dusts the hair with plaster of Paris, or some other mineral powder. This expedient is resorted to chiefly when a special kind of clipping is required, as happens in making fancy brushes for the teeth.

In many instances, the hair or bristles have to be bleached by sulphurous acid, or otherwise dyed of various hues. Tardieu reported that lead colours were at times used, and became a source of plumbism. To avoid producing dust, Vernois recommended the workmen, before rubbing the bristles between the palms of the hands in making up the tufts, to slightly moisten the bundles.

I have not met with any English statistics of the diseases and deaths of brushmakers as a separate class of the employed; but Hirt puts forth the statement that of 100 cases of sickness among them, forty-nine are due to phthisis, and twenty-eight to chronic bronchitis. These ratios must be accepted with great caution, as they are calculated upon the small number of fifty-seven diseased brushmakers found in different hospitals. Hirt himself avows that they unduly magnify the prevalence of those diseases among these artisans.

Judging from my own examination of a brush manufactory, the causes of disease to be seen are few and not very important. More pronounced evils are to be looked

for in places where the preparatory processes are conducted, and also in domestic workshops, referred to by manufacturers as 'garret shops.' In the latter, the efficient causes of disease are, doubtless, accidental, rather than incidental to the occupation. To the same class of causes we must look for an explanation of the vital statistics quoted by Hirt.

The making of the framework of brushes, whether of wood, bone, ivory, or other material, is followed as a separate trade, having its own special health features.

SUB-SECTION *b.—Occupations wherein Vegetable Substances are employed. Artisans Working with Wood* are very numerous, and their forms of labour remarkably various, differing among themselves particularly in the amount of physical effort required. They also vary largely in respect of outdoor and indoor work. The largest and best known subdivisions of these artisans are house carpenters, cabinetmakers and joiners, wheelwrights, coach and shipbuilders, sawyers, coopers, and turners. But there is a host of workers in wood engaged in small and special trades, such as packing-casemakers, makers of bobbins and other small articles connected with machinery, makers of chairs, of walking and umbrella sticks, and other special articles. In this same category may be inserted basket and crate makers.

To examine these many distinguishable departments of labour *seriatim* is out of the question, and I must limit my account of their hygienic features to generalities.

As to the degree of physical exertion required, there is, as said before, immense variety. It is considerable for house carpenters and shipbuilders, for sawyers, coopers and wheelwrights, and sometimes for turners; whereas it is slight in most kinds of cabinet work, in inlaying and cutting fret, etc. The work in timber yards and timber docks is frequently heavy, but this is rather the affair of labourers than of artisans. Sawing timber as formerly practised was a fatiguing business, but the invention and the present almost general use of the circular saw has deprived it of pretty nearly all heavy exertion.

The old-fashioned style was attended with unusual exertion of almost the whole body, and put a heavy strain

upon the respiratory and cardiac functions. The result was, that these men were short-lived, and suffered from asthma and bronchitis; and also, as sawpits were outdoor structures, from lumbago and other rheumatic affections. According to Mr. Ratcliffe's tables, sawyers formerly presented an inferior vitality of two years; and up to the age of fifty the expectation of life was beneath the average, though subsequently it became 1·36 year superior. Their average sickness was in excess up to the age of forty, after which it declined.

Respecting other employments above enumerated, it may be said of them generally, that they are amongst the most healthy of industrial pursuits. However, in the instance of turners an exception must be made, because of the dust generated by their work,—a circumstance hereafter specially illustrated in the chapter on dust-producing employments. And, without doubt, minute inquiry would establish some definite ill consequences as proceeding from the necessary manual labour of more or fewer of the other divisions of the group of artisans under consideration. An example of the truth of this remark is to be found in the fact first noticed by Dr. B. W. Richardson; namely, that carpenters, cabinetmakers, and other craftsmen, who at work throw the arms forward and draw them back sharply, get a subclavian thrill and murmur. This occurrence he explains by supposing that the repeated movements bring about hypertrophy of the subclavius muscle to such an extent as to modify the natural position of the vessel, so that the murmur becomes a permanent but harmless phenomenon (*Medical Times*, 1868, vol. i. p. 443). To hazard a criticism on this explanation, I am disposed to attribute the circumstance to the pressure caused by the hypertrophied muscle, and not to displacement only of the blood-vessel.

Broca communicated to the French Academy of Medicine, in 1880, a note on a curious deformity of the cranium, peculiar to sawyers of timber using long saws, in the form of a periostitis affecting the cranium. Inquiry proved to him that this came about from the very primitive mode of employing the head, without any protection, to push forward logs of timber,—a proceeding that would not be so

remarkable in a colony of negroes, but is certainly somewhat surprising in a country of advanced civilisation where machinery has reached great perfection.

The hands of carpenters who are much employed in planing increase considerably in breadth; and, where the chisel is largely used, their flexor tendons are apt to suffer contraction.

Sir Peter Eade, of Norwich, considered he had established the occurrence of partial paralysis among over-worked carpenters, accompanied by shortness of breath, vague pains in the chest, ascending to the back of the neck and head, and also by constant secretion of bronchial mucus and saliva. Along with these phenomena was a peculiar nervousness and fidgetiness of manner. He held that the brachial flexus was first involved, and that other portions of the nervous system afterwards suffered by reflex action in the form of tremor and weakness of limbs, consequent on exhaustion of the spinal cord. Pain and numbness of the fingers were the first symptoms, with shortness of breath and cough; and the tremor sometimes extended to the face and tongue. He met with three cases presenting like features in carpenters, and a further example in a 'navvy,' in whom over-strain of the arms appeared to be the cause (*British Medical Journal*, 1872, vol. ii. p. 289).

The remarkable extension of the effects of local nerve and muscular strain over a wide area is further exemplified by the phenomena of 'hammermen's palsy' (p. 183), which, unlike scriveners' paralysis, is commonly free from spasm, though sometimes ushered in by unilateral convulsions, with, as after consequences, facial, lingual and ocular paresis, and even agraphia and aphasia (*Lancet*, 1869, vol. i. p. 427).

Layet asserts that varicocele is of frequent occurrence with cabinetmakers, whilst others have persuaded themselves that hernia and varicose veins are especial grievances with carpenters. Of turners, it is stated that the left shoulder gets depressed, and the left hip more or less protruded, owing to the weight of the body being thrown chiefly on the left leg; whilst, at the same time, the left scapula bulges out from the subjacent ribs. This same deformity

happens to turners in fitting shops. Tardieu further adds, that an anterior sternal prominence or ridge is developed at the level of the second rib, surmounting a flattened space on the right side of the chest caused by lateral compression of the ribs.

The vital statistics compiled by Dr. Ogle show that carpenters and joiners have a mean annual mortality between 25 and 45, of 7·77, and between 45 and 65, of 21·74; their comparative mortality figure standing at 820; wheelwrights, shipwrights, and shipbuilders exhibit even more favourable results. On the other hand, sawyers, woodturners, box-makers and coopers, and coachbuilders have a heavier mortality; the turners and coopers surpassing all the rest by their unfavourable record. To elucidate this statement, we note that between 25 and 45 their mean annual mortality per 1000 living is 10·56, and between 45 and 65, 28·55; and their comparative mortality figure 1001. Not so far removed from them in these respects are the coachbuilders, who have a comparative mortality figure of 944.

On turning to the statistics prepared by Mr. Ratcliffe, we find confirmation of Dr. Ogle's figures. 'To the general results, and to the whole population of England and Wales (writes the former), carpenters and joiners have a superior vitality of six years, . . . and a higher expectation than any other class, except at the age of 20, when agricultural labourers show a slight superiority.' At age 20, their superiority is 4·55 years over the general expectation of life; and at other periods of life this superiority becomes increased. At 30 their average sickness is greater, but in subsequent decenniads it is less than the general result (*op. cit.* p. 45). Respecting coopers, Mr. Ratcliffe has calculated that, for every decenniad up to 60, their expectation of life is below the average, and their entire aggregate amount of sickness is 19 per cent. above the general rate (*op. cit.* p. 46).

Manufactures of Wood, Horn, and Ivory.—Of such is the making of sticks and umbrella handles, of bobbins and spindles for textile works, of handles for brushes and brooms, of chairs, and of handles for knives and forks.

The best account I have met with concerning these industries is found in the *Fourth Report of the Children's*

Employment Commissioners (1865). The principal factor of ill-health in all of them is the dust generated by sawing, drilling, and polishing the material used, whether wood, bone, or ivory; and it will best serve the purpose of description to treat these substances in one group. To begin with the occupation of—

The making of Sticks, and of Parasol and Umbrella Handles.—This industry is well suited to female and child labour, and, in consequence, the majority of workers are women and children. Before the Factory Act was extended to the occupation, labour was imposed with little or no regard to age, duration, or physical ability. and a large amount of sickness and suffering was the result. By the operation of that Act great improvement has followed; and as to incidental causes of ill-health, these are now chiefly confined to the dust developed, and to the lead paints or enamels used.

The several operations in the business consist in cutting, shaping, and drilling, and finally in polishing and varnishing or enamelling. Circular saws are used, and frequently cause accidents to the inexperienced and inexpert. In working the ordinary soft woods the dust is of small consequence; not so, however, when the harder woods, such as ebony and rosewood, or when bone and ivory are dealt with. Rosewood dust has an especially bad reputation, on account of its irritating and almost poisonous qualities.

The closer and harder the wood, the greater and finer will be the dust generated. But besides the density of the material, there are other circumstances influencing the quantity and the quality of the dust set free. Of these the chief is the proportion of animal or of a mineral material in the substance. Where mineral or inorganic matter is present, the dust is worse for health. Thus bone is more annoying to the lungs than horn dust, and fossil than recent ivory. Bone and ivory are employed in the bone-button trade, in the making of billiard balls and of handles, of knives and brushes.

To return to wood and its dust. Of the soft woods, as they are worked in this country, there is nothing to be said. Whether in the saw-mills of Canada and the United States, where timber is sawn upon an enormous scale, the men

employed in them suffer from the disseminated sawdust, we have no means of ascertaining. But our own workmen, who cut and polish such hard woods as ebony, especially in veneer cutting, and in making small articles, as knife and other handles, complain of the injurious consequences to their lungs of the dust produced.

After the shaping and turning of articles is completed, the operations of smoothing, polishing, and varnishing follow. For some sticks and handles a process of enamelling is superadded. The smoothing is done by sand-papering, with the result of detaching much dust. The varnish used for sticks is composed of shellac dissolved in naphtha and spirit, with the addition of a small quantity of either red or of white lead. This addition is necessarily of a dangerous character. When an enamelled surface is required, the composition is weighted with still more lead, with the result to the workpeople of more frequent plumbism. It has been the aim, as it should be, of the manufacturers to dispense with the use of lead, and there seems no reason why the harmless oxide of zinc may not be substituted for the poisonous lead salts.

The Bobbin and Spindle Manufacture is, as Mr. J. E. White (*Children's Employment Commission, Fourth Report*, p. 96) remarks, 'a trade subsidiary to the spinning and weaving manufacture. Its chief processes are sawing, turning, boring, and smoothing—all done with the help of machinery.' Conjoined with it frequently, is the making of spindles, brush handles, and other small wood ware.

The work is not laborious, and consequently falls largely into the hands of boys, to whom are intrusted many minor jobs; whilst the sawing and turning constitute the labour of men. This last-named operation entails more dust. A workman examined stated (*op. cit.* p. 100) that 'the amount of dust depends very much on the kind and size of the bobbins, the dryness of the wood, and also on the kind of wood. Hard foreign woods are the worst. Ebony is like a solid substance inside you, and if you come to cough and spit, it comes out like a round lump. It also tickles the nose and makes you sneeze like snuff, and makes your eyes twinkle.

In all kinds, the work is reckoned very bad for the stomach. The dust gets in and causes indigestion; and the way we work, leaning over, etc., causes a bearing down of the chest. The haft of the chisel rests just touching the chest, but only lightly.'

The sand-papering after turning is, however, the most dusty business, particularly in the case of large bobbins.

The inhalation of the dust provokes spitting, the sputum containing much diffused dust; and the medical man at Windermere (Dr. Dobson) expressed himself as satisfied that the occupation was particularly productive of pulmonary consumption, of strumous disease of the bones, of dyspepsia and anæmia. Besides the stooping posture, the pressure against the chest when turning is done, confinement in the factories,—which for the most part are small, structurally unhealthy and badly ventilated—and indifferent food, are largely contributory to the ills mentioned.

Chairmaking has similar sanitary conditions to the two preceding manufactures. As with them, the chief operations are sawing, boring, and polishing or smoothing. To these are to be added those of varnishing and staining. We consequently meet with the like development of dust.

A physician living near Wycombe drew my attention to the injury inflicted by the use of the auger for drilling,—this tool being strongly pressed against the upper part of the chest, for the purpose of steadying it whilst the right hand is engaged in revolving it to bore the hole required.

According to the same informant, this pressure caused depression of the topmost ribs below the clavicle, and set up disease in the subjacent lung, which usually advanced to the development of phthisis.

Artificial Flower-making ranks among mechanical trades, although the mechanism required for it is of very simple character. It is a trade that strongly arrested public attention some years ago in connection with the sad results flowing from the use of arsenical colours. This matter is treated of in the chapter on poisonous materials used in manufacture. Apart from the injuries that may arise from the cause just

mentioned, the occupation is free from any incidental conditions adverse to health, excepting its highly sedentary character,—an evil inseparable from it,—and the strain involved of the organs of sight. It is pre-eminently an occupation for women and young females; but a few boys and men are employed at some shops, to stamp out by hand-machines the leaves, or petals, and to impress the veins on their surface by means of dies.

Being a trade under the influence of fashion and of the season, work in it is apt to be irregular; and lack of work implies privation on the part of many of the employed, and moral evils in the case of young women. At other times, overpressure from orders received would be attended by overwork, were it not for diligent supervision on the part of the Factory Inspectors. There is little doubt that, in the case of domestic workshops which escape the vigilance of those officials, both overwork and overcrowding are common.

The colouring is done by either men or women. To quote Mr. Lord's account of the business (*Children's Employment Commission Report*, iv. p. 110)—'The great majority of the women and girls are engaged in putting the petals together, so as to make the flower; in forming the "culo," or the foundation on which the petals are stuck; in gumming, waxing, dusting (with potato flower for bloom, or with powder of blown glass for frost), twisting paper or silk thread on to the stalk, and in other details. . . . The younger children have generally to open the "cuts," or layers of petals, etc., which have been stamped out, and to separate them into the sixteen or more pieces of which they consist. For this purpose they use a pair of pincers or plyers; they also have to pass a fine wire through the centre of each of such pieces, when the flower has to be made in that way. Twisting thread round the wire to form the stalk, and threading beads, are also common occupations of children. Some are allowed to use a small goffering-iron to curl the petals. All this involves delicate manipulation, and a great strain upon the attention of a child, particularly at the end of a long day's work and by gas-light.' From one and another of these operations the fingers and hands frequently get sore and blistered, whilst the twisting of wire and silk on the

stalks, by constant friction, cuts into the nails and skin. The use of the heated goffering-iron likewise inflames the skin, and at times induces cramp of the hands, disabling the worker for a while. The opening of the 'cuts' sets free a great amount of dust, which causes irritation of the eyes and of the respiratory passages. The bright colours in use are very trying and tiring to the eyes, as are also the operations of picking up and threading small beads, and of affixing these to the blades of grass to imitate dewdrops.

The shops are often hot and close, especially those to which the drying-closets adjoin. The free use of gas is another source of heat and of depraved air. The making of white flowers by gas-light is found to be most dazzling and trying to vision.

Mr. R. Taylor, surgeon to the Central London Ophthalmic Hospital, reported that artificial flower-makers 'suffer in one of two ways; either from that form of weak sight known as asthenopia, which is common to all employments in which the eyes are continuously and carefully used; or from chronic inflammation of the eyelids. I consider that this is caused by the dry coloured dust, . . . which is conveyed to the eyes either directly by the fingers, or by floating in the air' (*Report, cit.* p. 119).

The preceding account conveys a sufficiently clear notion of the incidental and accidental circumstances of the business of flower-making. They are, in brief, sedentary labour, a stooping position, want of healthy movements of the arms, minute and painstaking work, demanding close attention and the exercise of skill, both in design and manipulation, strain of the eyesight by strong colours and by much artificial light, long confinement in heated workshops, frequently deficient ventilation; exposure to the inhalation of dust, now and then of noxious properties; and, lastly, unsteady or irregular work. No special investigations of the sickness and mortality of flowermakers has, to my knowledge, been made; but the list of conditions adverse to health are suggestive of the prevalence of phthisis, anæmia, and disorders of digestion.

Papermaking was some years since much more nearly allied to the textile trades than at the present day; for at a long past period linen rags constituted the sole material from which paper was made. Now it is found that a large number of plants, especially those of the order Gramineæ, furnish fibrous material convertible into paper. Thus, besides linen rags, straw, esparto and other grasses, old rope and paper are employed; and latterly the wood of Norway firs and the fibrous peat from moors and bogs. Where rags are used, the first process is that of sorting. This is done in a rough manner at rag and bone stores before the rags reach the mill; but a more careful sorting is afterwards proceeded with to separate white from coloured rags, as the latter are not adapted for white papermaking.

The emptying of the sacks as received, the subsequent sorting, and the transfer of the rags to the cylinders, in which they are boiled under high pressure with caustic soda, are the only processes in which dust is set free, excepting that which escapes from the 'devil,' or tearing-up machine. The boiling in the cylinders reduces the rags to a soft, fibrous mass, which, having passed through one or more other machines, forms the necessary pulp to be converted into paper, requiring only the bleaching and colouring desired. The bleaching is done by the admixture of chloride of lime, or by the introduction of chlorine itself. In the former case, the diffusion of the dust of the bleaching powder can be prevented by previously moistening it; in the latter, care has to be taken to guard against the escape of the gas.

It is almost needless to say that there are diversities in the machines used in different factories, consequent on preference given, and in the nature of the material to be converted into paper. Thus, when straw is employed, the preliminary process is to cut it up into chaff by a steam chaff-cutting machine. When logs of wood are used, they are cross-cut into small fragments by a powerful machine. The essential processes thereafter are all directed to the production of a pulp, followed by bleaching where necessary, and then by the later operations of straining off the water, and the producing of an adhesive film, to be gradually dried by heat and pressure, until it assumes the form of paper.

When this is effected, the paper is cut to the required size and pressed by machines, whence girls remove it and lay the sheets in reams, ready for packing and exportation. These operations are not in themselves unhealthy. Heat and indoor employment alone are the unhygienic factors. I have noted the addition of chloride of lime to the pulp for the purpose of bleaching it. Other additions, but for no like admirable purpose, are made in the form of china-clay, barytes, and other powders, to give fictitious weight and solidity to the manufactured article; additions calculated to cause annoyance to the bibliophiles of future ages.

The modern improved mechanism described has greatly simplified and accelerated the making of paper. It has diminished sources of dust and abolished the noisy 'beaters,' employed of old to pound the rags into pulp. The business of sorting is simplified by the tearing up ('devil') machine now used, and therewith the production of a great quantity of dust, itself at times charged with germs of disease obviated. Formerly the first tearing up of rags was done by hand; the rags being pulled against an upright cutting iron or knife fixed on the working table in front of the sorters. The modern plan saves this tedious, dirty, and unhealthy process, and greatly reduces the number of sorters employed. In roomy and well-ventilated sheds the evils of dust in sorting will be small.

In all probability the evils of sorting are to be especially looked for in the rag-stores, where the operation is commenced; and experience has shown, that not only may the dust from sorting operate as a simple mechanical irritant, but also as a distinctly poisonous matter. This circumstance has been observed in this country at rare intervals, when foreign rags have been dealt with; but was more seriously exemplified by an outbreak of a febrile malady in Riga, evidently due to septic matter, as recorded in the *British Medical Journal* for 1887 (p. 343). It occurred in a paper manufactory among the sorters, and was investigated by MM. Shultz, Kranhals, Herrgraven, and Radecki.

The primary symptoms observed were—tremors, high temperature, general malaise, headache, dyspnœa, moderate expectoration, and a weak pulse. When the cases proved

fatal, temperature fell, the pulse grew weaker, and cyanosis and collapse ensued. After death rapid decomposition took place, and examination showed the existence of pleural and pericardial effusion, with enlargement of the bronchial glands and spleen.

The history given of this septic malady is the more satisfactory, inasmuch as the blood and various internal organs were examined for bacilli, with the result that *three* distinct microbes were found in the blood:—some like Koch's bacilli of œdema, others arranged in rows, and others again, resembling cocci. They were most numerous in the parenchyma of the lungs, in the bronchial tubes, and in the areolar tissue of the mediastinum.

The fluid of the pleural effusion injected under the skin of a dog caused malignant œdema and death in three days; and cultivation proved the identity of the bacilli with those described by Koch in malignant œdema, with which disease Kranhals classes this serious malady of the rag-sorters.

No one can fail to be struck with the analogy of this epidemic with the wool-sorters and hair-workers' disease; and it is right to mention that Bollinger reckoned anthrax as an occurrence among sorters of rags intended for papermaking.

A lesson suggested by this fatal outbreak of a septic malady among rag-sorters is, that these work-people should be protected against such casualties by subjecting the rags to some antiseptic treatment prior to future use. That some protective measures are needed, is, moreover, indicated to be necessary by the breaking out, ever and anon, in rag and marine stores, of scarlatina, small-pox, and other infectious diseases, spreading afterwards to the surrounding population. A very recent local outbreak of smallpox in a small Kentish town, was attributed to rags imported into the place for papermaking.

On the whole, dangers to health are of small moment in the manufacture of paper, when the possible evils attendant on sorting and tearing up of rags are excluded. What other perils do exist are present in the high temperature in certain departments, in the disengagement of steam, often of a sickly odour, and in the occasional diffusion of chlorine or of the dust of bleaching powder.

Bookbinders,—according to vital statistics, have a mortality ratio much higher than might be anticipated, regard being had to the character of their work and the materials in use. We are disposed to attribute this circumstance rather to purely accidental conditions of labour than to incidents actually pertaining to the occupation; and foremost among those conditions, to the neglect of essential hygienic rules in the places of work. There are two principal classes of bookbinders, the one occupied in leather binding, the other in cloth binding; and besides these two departments there is a large band of stitchers. These last are exposed to the incidents of sedentary labour, and far the greater part are females. The operatives in cloth-binding rank as an inferior grade, and the stitchers as a still lower one. Considerable muscular effort is required in screwing up the presses to fix the volumes to be cut, and afterwards in working the planes.

Cutting and trimming the 'cloth' for covers causes a little dust, and the binding operations are accompanied by heat, and by the rather offensive steam from melted size and from the putrid cement, made from the serum of sheep's blood. The work forbids active currents of air, and consequently binders keep their shops hot and close. Although the death-rate of bookbinders was less heavy than formerly, it was still high when Dr. Ogle wrote: 'Their mortality figure being 1167, whilst that of printers was only 1071.' The record of causes of death exhibits 30 deaths from consumption, out of a total of 77 deaths; an enormous percentage, viz., 38·9. Moreover, diseases of the respiratory system produce 12 deaths, and nervous maladies 11.

It is right, however, to notice that the number 77, of total deaths, is too small to afford a certain basis for statistical deductions. Reverting to accidental health conditions, it is worth while to consider how far this trade may attract recruits of weak constitutional powers; and again to what extent the small wages (with their accompaniments of poor nourishment and bad lodgings)—earned by stitchers, assist to raise the ratio of mortality.

In fine, we need more insight into the details of the mortality returns of this class of artisans; because, especially when small totals are dealt with, the consequences of the

business, as represented by figures, will be seriously affected. As to the relative mortality of this or that branch of the trade—for the several branches vary widely in their possible influence upon health—I can get no information, and even their benefit society appears unconcerned about their vital statistics, for none are kept by it. In the absence of published information, I applied to Messrs. Watkins & Co., the large binders at Camberwell, employed by the Bible Society; and they were kind enough to supply me with some memoranda, which, unfortunately, carry no great weight by reason of the small number of deaths on record.

The number of the employés is 376, of whom 110 are males and 266 females. Of these, 197 had been engaged in the firm from 10 up to 53 years. The remainder, 179, had worked less than 10 years. Of course the number of those who had worked from 40 to 50 years was small, namely, 10; whereas such as had been employed between 20 and 40 years, reached the respectable total of 88, and those from 10 to 20 years amounted to 81. Thus it turns out that of the entire number of employed, more than the half by 18 had carried on their occupation for above 10 years in the same firm.

These figures prove, as Messrs. Watkins observe, that bookbinding, as carried on in their place of business, 'is anything but an unhealthy occupation.'

The statistics of deaths also supplied me for the ten years, 1880-1889, point to the same truth. Within that period, out of the 376 hands employed, there were 11 deaths of males and 13 of females. Of these, 3 are referred to 'decay of nature,' at ages of 67, 70, and 76, among the males. The females furnish none under this heading, although there were two deaths, at 72 and 74, and two at 60 and upwards severally assigned to paralysis, bronchitis (3) and unsound mind. Of the more aged men one died of apoplexy at 60, one of rheumatic gout at 55, and one of cancer at 50. Phthisis is put as the cause of death in four males, aged severally 54, 45, 40 and 35; and in three females at the ages of 23, 20 and 19. One young man at 18 perished from typhoid fever, and one woman, aged 20, from inflammation of the bowels; one from bronchitis at 47, one from heart-disease at 44, and two, aged respectively 15 and 21, from congestion of the brain.

Taking, therefore, into account the total number employed and the age distribution, and reviewing the recorded causes of death, no evidence is got to show that the occupation shortens life by any inherent unhealthy process, or that it is the active agent in setting up any special disease. Still, on comparing deaths from phthisis with the total mortality, the ratio is certainly high, that malady being accountable for 24 deaths, or 29 per cent. When, however, the mortality from it is calculated on the entire number employed, its percentage amounts to only 1·86 for the whole range of ten years. It is also deserving notice that, in the case of the female binders, the deaths from phthisis happened at the early ages of 19, 20 and 23; a circumstance indicating that the onset of the malady was due rather to original predisposition and weakness than to the conditions of employment. And this consideration need be taken in conjunction with another, viz., that bookbinding, and particularly book-stitching, will be adopted as an avocation by the less robust and healthy.

CLASS II.—*Occupations raising New Material from the Earth.*

SUB-CLASS I. *Agriculture.*

SUB-CLASS II. *Mining.*

SUB-CLASS I.—*Agricultural occupations* include agriculture or farming, and the business of horticulturists, of market-gardeners, and of foresters. These I shall speak of together, since they have one incidental character in common, that, viz., of being outdoor employments. The cultivation of the soil is the primitive employment of man on ceasing to be nomadic, when he looks rather to the produce of the earth than to that of the chase and of his flocks and herds. It possesses all the elements for developing his bodily powers and maintaining health, provided only that the selection of the food he eats and the clothing he puts on be regulated by the climatic conditions of the land he dwells in.

The more closely agricultural operations assimilate to the simple cultivation of the soil, the more healthy generally,

may they be considered. When the growth of plants has to be fostered by artificial care under glass, and those engaged in it become thereby to a great extent indoor workers in an artificially warm climate, hygienic conditions are introduced distinctly disadvantageous to health, and the culture of plants is transformed into a kind of manufacturing process.

The advantages to health of outdoor agricultural operations are best shown by comparison with occupations which entail town residence and indoor sedentary work, or by contrast with the hygienic conditions of mining. Statisticians refer to purely agricultural districts for a standard of normal existence and human vitality. Dr. Greenhow, in his *Papers relating to the Sanitary state of the People of England*, employed very largely this plan of comparative statistics, particularly for the purpose of bringing out the fact of the influence of employment on the mortality of the people. And Dr. W. Ogle has an interesting paragraph in his *Appendix to the Registrar General's Report*, so frequently quoted (p. 57), to illustrate the 'influence of fresh or foul air' on health. His comparative mortality tables point to the same truth; farmers and graziers, gardeners and nurserymen standing next to clergymen in the value of life. The comparative mortality figures of the two former is 631, and that of the two latter 599; the clergy being represented by 556. In the table of comparative mortality, farmers and graziers present lower figures than those calculated for all males, under every heading, excepting liver-diseases, which count for 41 instead of 39. Phthisis stands at 103 in place of 220, but diseases of the digestive system reach 30 as compared with 38 for all males, whilst alcoholism produces 6 deaths as compared with 10, and gout, 2 as contrasted with 3. These comparative figures point to a considerable amount of good living and of alcoholic indulgence among farmers and graziers; a fact every one acquainted with these traders is prepared to indorse, especially in the case of graziers, for the men returned under the latter designation will comprise a large proportion of individuals of wandering, dissolute habits, and extremely exposed to the inclemencies of weather.

The farmer should take the foremost place in a health

calendar, for the incidents of his calling are, on the whole, superior to those of the clergy. They are, however, thwarted by the sin of over-indulgence, not at all times, but mostly at the visits made to markets and fairs, where the hotel 'ordinary,' convivial society, and above all the striking of bargains, lead to the too free consumption of intoxicants.

Gardeners and nurserymen show better returns, especially under the headings Diseases of the liver and of the digestive organs, and of Alcoholism. On the other hand, farmers and graziers exhibit more favourable results in the matter of phthisis, and of diseases of the respiratory and of the urinary system. Nevertheless, under all headings taken together, gardeners and nurserymen stand above all other occupations —the clerical excepted—in life valuation. That they should have a higher mortality than farmers from phthisis and lung disorders might naturally be anticipated. Their work is not entirely outdoor, but, in the case of many, carried on in hot-houses and conservatories; and where this indoor occupation does not prevail, their labour is less vigorous and bracing than that of farm work, whilst it entails much stooping and long exposure frequently to wet.

The relative figures for phthisis and respiratory diseases are respectively, for farmers, 103 and 99; and for gardeners, 121 and 111. The causes of the somewhat greater prevalence of urinary diseases with the latter are not obvious; but the happier relative exemption of gardeners from hepatic and abdominal lesions is referable to their escape from the temptations of markets and fairs, and from a mischievous trade usage of treating.

It is impracticable to separate agricultural labourers from farmers in this sketch of hygienic conditions and diseases. The work of the practical farmer and of his labourers is pretty much alike, except it be in the degree of physical toil. Inquiries as to diseases prevalent among them as a class tend to no very definite conclusions. These, so far as they go, are of the *à priori* description. Thus, it can be predicated that exposure to wet and cold is productive of rheumatism, as well as of inflammations attacking the internal organs; and when we look to the condition of old outdoor farm-labourers, we find few unaffected with chronic rheumatism, or with

its congeners, sciatica, lumbago, and rheumatic arthritis; or else with chronic bronchitis, and a considerable ratio of heart-disease. My own observation has made me pretty well acquainted with the health-features of farmers and farm servants; but as I desired my views to be confirmed by others, I sought the opinions of some of my neighbours practising in purely agricultural districts, and received from Dr. John Tylcote, of Sandon, a letter full of very interesting information. From this communication I gather the following particulars:—that disorders of the respiratory organs and phthisis are most rife from the end of October until the end of April; a period during which the atmosphere is foggy and damp, and charged with emanations from the *débris* of fallen leaves and dead vegetation. Phthisis is common, but less so among adult males than among females and youths of both sexes. Its occurrence is favoured by want of drainage, by unhealthy habitations, and by insufficiency of good nutritive food. Intermarriages are common; the existence of hereditary taint being disregarded. The babies are suckled too long, with the hoped-for purpose of avoiding pregnancy; or, if weaned early, are fed upon bread soaked in sweetened water, and when somewhat older on potatoes and tea. Milk is rarely used; for even when cottagers keep one or more cows, their prime object is to make as much butter or cheese as they can; and they choose rather to feed their pigs with the butter-milk than to use it as nourishment for their children. From these causes their young ones are very largely subject to enlarged tonsils, to strumous glands, to anæmia, and general feebleness of constitution.

That phthisis prevails to a greater extent among the women than the men is to be accounted for by their indoor habits, by the exhaustion of bearing and suckling offspring, and by the circumstance that they are not so well fed as the men. Moreover, especially in dairy farms, the females employed are worked to great excess. They are required to rise very early in the morning to milk the cows and give them the necessary attention. As a matter of course, this duty subjects them in winter and bad weather to cold and wet, and this too at an early hour before food has been taken. The same business has to be repeated in the evening, and in winter,

and in all weather, and when accomplished is followed by many other duties enforced by the requirements of butter or of cheese-making. Where cheeses are made they require daily turning over for a considerable period, in the storeroom; an operation demanding great exertion, and one that, in my experience, frequently causes a breaking down of health, with anæmia and uterine troubles, and is contributory to the lighting up of phthisis. Hernia, likewise, is an occasional result. To return to Dr. Tylecote's notes. He confirms what has already been stated relative to the general prevalence of rheumatism among agricultural labourers as they advance in life. Not that acute rheumatism or rheumatic fever is frequent, but a chronic form of the malady—for the most part, a crippling kind of rheumatic arthritis. This is attributable to exposure, to cold and wet; particularly in the work of hedging and ditching, which is done in the colder and wetter portion of the year. But if acute rheumatism be but rare, and heart-disease not directly associated with it, the latter is nevertheless very common, and may be assigned to chronic rheumatoid degenerative changes of structure of the heart and arteries. When Dr. Tylecote has met with cases of acute rehumatism it has been mostly in young women. Unfortunately, obituary returns fail to exhibit the prevalence of rheumatism in any class. That more consumption and greater degenerescence of races has not attended the gross indifference to the housing of the agricultural labourers in former years, is something to wonder at. The wretched state of cottage accommodation in 1842, when a Royal Commission, composed of several special assistant Poor-Law officials, prosecuted researches into the employment and housing of the agricultural working classes, was abundantly demonstrated by their report; and, unhappily even at the present day, in outlying districts where landlords are not resident, or else callously indifferent to the well-being of their tenants, there are habitations presenting the like wretchedness to that described in that report. Sanitary enactments are rendered inoperative by reason of their enforcement being lodged in the hands of small local authorities, composed, in districts such as alluded to, chiefly of tenants of the great landlords, and whose first principle of

action is to avoid offending the great men, lest their position should suffer.

To return to the expressed opinions of the Commissioners, they concluded that outdoor farm labour was, on the whole, beneficial to grown-up women, who themselves, nearly without exception, represented it as good for their health and spirits. The surgeons examined quite concurred in this belief, but with this reservation, that for girls about the time of puberty, such work was not desirable, chiefly on account of frequent exposure to wet. With regard to pregnant women, the doctors agreed that field work scarcely ever proved an evil, and the only conditions they urged as necessary to their well-being, were the wearing of appropriate warm clothing and the supply of sufficient good food. With regard to dairy-women it was considered they suffered more from fatigue, and were oftener overworked than women engaged in the fields.

The conditions antagonistic to the good effects of outdoor field labour were miserable wages, indifferent and insufficient food, and crowded and insanitary cottages, often unfit for human habitation. Since this report was made considerable reforms have been effected; though, as above remarked, they are still far from complete.

As is well known, agriculturists who have to do with animals are liable to contract contagious diseases from them. From horses they may contract glanders, and from cattle foot-and-mouth disease, and, it would seem, scarlatina has seized on those milking diseased cattle. Ringworm is tolerably frequently caught from cows, it being a common practice for the milker to press the head against the flanks of the cow. Another evil overtakes farmers and their men, in the shape of hernia following upon overstrain in harvest time, in mowing or in loading waggons.

As the various occupations in which dust plays a primary part in inducing disease have hereafter to be fully examined, it is enough, in this place, to mention that threshing corn and cutting chaff evolve considerable dust, provocative of lung irritation. In scattering lime as a manure the same circumstance happens. But when bones, guano, and other dry manures are used, the dust emitted seems in preference to affect the gastro-intestinal mucous membrane and to cause colicky pain.

As is well known to everybody acquainted with rural districts, outbreaks of contagious diseases are by no means rare, often in farm-houses and cottages completely isolated; and the usual history of these occurrences is that of woeful neglect of all sanitary requirements, both of the person and of the habitation, and of gross folly in communication between the sick and the healthy. Add to these circumstances the demonstrated transmission of disease by milk, and, as some observers say, by the medium of the cows themselves.

Mr. Prince, in his interesting book on *The Climate and Statistics of Uckfield in the Weald of Sussex*, a purely agricultural region, presents the following statistics, collected over a period of thirty years, and for a population of 2659. Zymotics produced less than one-half the calculated ratio of mortality for the whole kingdom, but diseases of uncertain seat, cancer, dropsy, gout, and sphacelus were nearly double, and constitutional diseases, represented by scrofula, tabes mesenterica, phthisis and hydrocephalus, caused a mortality 283·62 in place of 162·22. The next class of maladies, paralysis, apoplexy, convulsions, cephalitis, and nervous disorders of uncertain seat, stood at 152·72, as contrasted with 123·99. Heart affections and others in class iv. were 41·81 to 33·01; but respiratory diseases (class vi.) were one-third less; diseases of digestive organs somewhat less, whilst those of the kidney were nearly double, as 17·27 to 9·54, and the excess of disorders of the generative organs still greater, namely, as 17·27 to 7·49. Premature birth and debility are put down as 84·45 to 67·45 for the population at large.

These figures are instructive with regard to the entire population of an agricultural district; but they are not rightly comparable with the statistics we are concerned with, applying only to individuals above fourteen years of age. The most pronounced divergencies in vital statistics of the Uckfield population from those of the country at large are seen with respect to constitutional diseases, including phthisis, to diseases of the kidneys, and to those of the generative organs.

A SUPPLEMENTARY CHAPTER ON THE INHALATION OF DUST—ITS PATHOLOGY AND SYMPTOMATOLOGY

FEW, indeed, are the occupations in which dust is not given off. In none can it be absolutely harmless; for the lung tissue must be just so much the worse, and less efficient for its purpose, in proportion to its embarrassment by dust. We all recognise the difference in the fulness and freedom of respiration, according as we happen to breathe the dusty and smoky atmosphere of a city, or the pure air of a mountain or of a wide-spreading prairie. Happily for us, we can long survive breathing the air of a city, but we cannot rival in respiratory efficiency the dwellers in the open country, and sooner or later, *cœteris paribus*, according to original constitutional vigour and modes of life, the intimate tissue of the lungs looses its elasticity, and gets permeated by inhaled dust,—a fact illustrated by the increasing superficial blackness of those organs, as life advances, in the case of all dwellers in large towns.

What occurs to the ordinary citizen becomes magnified ten or a hundredfold to those engaged in dusty occupations, and more especially where the dust itself possesses noxious properties. But unless dust has this latter quality, it is remarkable with what indifference its inhalation is treated by the majority of workmen. In one sense, indeed, it is unfortunate that it does not, for the most part, awaken attention by any immediate tangible consequences. Its disabling action is very slow, but it is ever progressive, and until it has already worked its baneful results upon the smaller bronchial tubes and air cells, and caused difficulty of breathing, with cough and spitting, it is let pass as a matter of indifference,—an inconvenience of the trade.

Were it always charged with some noisome smell, or did it obviously and quickly strike down its victims, like the unseen poison of fever, it would not fail recognition in all its pernicious forms and consequences.

Bronchitis, asthma, fibroid and tubercular consumption occupy a foremost place in the category of causes of British mortality; and without doubt these maladies are largely attributable to the inhalation of dust, operating *per se*, or in conjunction with constitutional proclivities and insanitary surroundings.. Pathologists tell us of the presence of bacilli in tubercular disease, and favour the belief that these minute bodies are the cause of it. This notion may represent a whole truth, or only a partial one; in my opinion, the latter. For I doubt if these bacilli actually develop phthisis, unless there be some antecedent change in the vitality of the affected tissue; a change wrought by depressing causes connected with the mode of life, or with constitutional debility and inherited taint, or with the occupation followed; of which contributory factors two or more may co-operate. And assuredly the breathing of dust may be reckoned as one such of no slight energy. In other words, I look upon a phthisical lung as one prepared for the germination and multiplication of bacilli, and not a primary product of those microscopic organisms, nor of the products of their organic existence. And I find an analogy in the vegetable kingdom, where failing plant vigour is the precursor of the appearance of devastating fungi, and not the fungi the starting-point of plant death. The spores of fungi light upon a tissue in which vital forces are failing, and allow the development of abnormal fluids, and in the altered organic matter those spores find a suitable nidus for growth. Having established themselves, the fungi now become active agents in breaking down the vegetable tissues. Plants full of vigour will resist the attacks of fungi falling upon them from neighbouring plants of the same species.

So it is, I believe, with bacilli; they require a weakened tissue to give them foothold; but having got it, their vast powers of propagation, and the transforming action of their vitality on surrounding material, render their action highly destructive. That the injection of bacilli into the blood will

start tuberculosis is a fact that does not contravene the foregoing view. They have thereby obtained a non-natural access by the agency of the blood, which brings them into immediate relation with tissues in process of degeneration or of decay,—that is, with tissues in a state of weakness, and unable to resist their attacks as epiphytic organisms; on the one hand, abstracting from them the necessary elements for complete formation; and, on the other, poisoning the plasma by metamorphosed products, the result of their own vital endowments.

It must be accepted as a fact that dust induces a malady bearing a strong similitude to tubercular phthisis, and yet that the malady is *not* tubercular in its actual nature.

In cases of potters' consumption from inhaled dust, occurring under my own observation, bacilli have been sought in vain, excepting where hæmoptysis, hectic, and other indications that tubercular mischief has been at work, as accessory or collateral. For experience proves that the dust-produced lung disease may co-exist with tubercular phthisis; and, further, that where labour is prosecuted in a dusty atmosphere tubercular mischief, in those constitutionally predisposed to it, is more likely to arise.

For a long time it was debated whether dust could find its way into the lung parenchyma. That it could not was a hypothesis long upheld by the eminent pathologist, Professor Virchow. However, oft-repeated experiments and observation have demonstrated that the ciliated epithelium of the air passages offers no lasting obstacles to its entrance, and have confirmed the views of those two former distinguished professors of the Edinburgh University, Drs. Gregory and Christison, who convinced themselves that, in the case of miners' lungs, carbon was intimately diffused through the pulmonary tissue. Since their time, Zenker's striking cases of red colouring of the parenchyma, generally from the inhalation of a red dust, have banished all doubt about the matter.

Writing in the *Transactions of the Pathological Society of London*, for 1869, Dr. Headlam Greenhow, after a careful description of the intimate structure of some dust-laden lungs, says that, from the results of his own examination

of miners' lungs, 'I arrived independently at the conclusion that the "black pigment with which their lungs are coloured is derived from the soot and smoke" they inhale' (p. 56); an opinion, he adds, supported by the several examinations subsequently made of the lungs of various other workers in dusty occupations.

In 1875 I contributed an essay 'on Lung Disease from Inhalation of Dust,' to the *British and Foreign Medico-Chirurgical Review*, of which I was at the time editor, in which I discussed the whole question in connection with the lungs of potters and colliers, and, I consider, then demonstrated that dust penetrated within the intimate structure of the lungs.

An interesting addition has of late been made to our knowledge of the pathology of lung disease caused by breathing dust, in the volume entitled *Lectures to Practitioners*, by Drs. W. T. Gairdner and Coates, 1888,—a volume replete with valuable lessons and with original researches. To Dr. Coates we are indebted for a minute examination of the lesion in a potter's lung, confirmatory of conclusions now generally admitted. It would not be just to omit notice of the interesting account of cases of carbonaceous lungs by the late Dr. Hughes Bennett, of Edinburgh, accompanied by excellent comments, and replete with practical deductions, contained in his *Treatise on Medicine.*

Up to a certain period in the history of a case, it is clear that inhaled dust is expelled by coughing, induced by its irritation of the larynx, trachea, and larger bronchi. A catarrh is set up, and along with the augmented secretion of mucus more or less dust is expectorated. Continued exposure to the same irritation renders the catarrh chronic, and after a longer period local interstitial inflammations ensue, ending in dense fibrosis, with obliteration of all normal structure. The first phenomenon in the sequence of events is the loss of its cilia by the bronchial epithelium. This is followed by a degeneration of the epithelial cells, which become fatty, and no longer resist the entrance of particles of foreign matter. The result is, that these last presently penetrate the alveoli, following the general current of the extra vascular fluid on its course

through the lymphatics and bronchial glands. As the late distinguished pathologist, Dr. Wilson Fox, observes, in his work on the *Pathology of the Lungs*, the 'dust enters by the pseudostomata of the lymphatic tracts, which open between the epithelial cells of bronchi and alveoli.' Or, otherwise, it enters 'by penetration into cells, either epitheloid or lymphoid, or derived from the white corpuscles of the blood, which pass by the same tracts to deeper tissues, and may there be found in an enlarged form, thickening the walls of alveoli or the interstitial tracts. Then follows induration, for 'Epithelial proliferation takes place within the alveoli,' producing thickening of their walls and of the interstitial tissue —the proliferation being a pneumonic process, eventually obliterating the alveoli, and transforming the spongy texture of the lungs into a solid fibroid tissue, often of extreme hardness.

The recent account given by Professor Coates of Glasgow, corresponds in all essential points with the above description. The black pigment is found in the alveoli, the bronchial glands and walls of the bronchial tubes, and in the mass of newly-formed connective tissue which constitutes the special focus of the lesion. The siliceous material derived from potters' clay is also to be seen in the form of angular transparent particles, both in the connective tissue and in the walls of the bronchial tubes, sometimes aggregated in considerable quantity, with the characteristic refraction of silex when placed under the microscope. 'Even in the lung alveoli, where the carbonaceous pigment is contained in large catarrhal cells, careful focussing will often bring out the fact that clear siliceous particles are present as well' (p. 157).

In my essay alluded to, I called attention to the presence of carbonate of lime in the diseased tissue of potters' lungs, as shown by effervescence on the addition of an acid. This incident would not be unanticipated, considering the composition of the clay used; and in the case of limestone dust, it is to be looked for in larger proportions. Indeed, its presence in minute quantities will be probable in all the more serious cases of lung fibrosis, where condensation and progressive devitalisation have been a length of time in operation, since we know that calcareous degeneration is a common phenomenon where tissue is losing its vitality.

The extent to which dust permeates the lungs, and the power of these organs to expel it is illustrated by Merkel's observations on ultramarine workers (*op. cit.* p. 138), in whose sputa the coloured dust was recognisable for fourteen days after cessation from work. He adds that this is the maximum period, unless the chest trouble has advanced to a state of permanent organic change.

The same writer recounts his own experience after half-an-hour's sojourn in a very dusty shop, where gasburners were in course of being made from steatin or soapstone, composed of magnesia and silica. The consequence was an intense catarrh, affecting the nose, larynx, and trachea, with expectoration of mucus containing a quantity of particles of the mineral disseminated in it, and shortly after, cells enclosing those molecules, and perceptible twenty-four hours subsequently.

How far and how widely inhaled dust will penetrate depends on various collateral circumstances residing in the form and quality of the dust itself, and in the circumstances accompanying its inhalation.

Thus soot and coal dust have remarkable power of diffusion throughout the parenchyma, far exceeding that of the dust of metals and stone. The former makes its way without lighting up the like resistance by its irritant action that the sharp particles of metal and stone do. We can also well conceive circumstances connected with the fulness and freedom of respiration, such as a heated atmosphere and rarefied air, the commingling of the dust with abnormal gases and vapours and individual peculiarities of the breathing organs, which must affect the dosage, so to speak, of the inspired dust.

One practical lesson is to be gained by these considerations—namely, that persons predisposed to respiratory diseases and phthisis ought not to engage in dusty occupations.

This foregoing sketch of the minute pathology of lungs suffering from the inhalation of dust applies with few exceptions, whatever be the dust. In a coarser pathology, there is a general resemblance in the resultant lesion, be the dust what it may. In the lungs of old people the boundaries of the lobules are marked out by black lines and spots, which

may be followed within the lung substance, in connection with the perivascular and peribronchial connective tissue, and in the lines of the lymphatic circulation.

We are greatly indebted to Dr. Headlam Greenhow for many careful and minute examinations of diseased lungs taken from various workmen employed in several of the principal dust-producing occupations.

The facts he noted are well described and figured in the volumes of *Transactions of the Pathological Society of London*; and we learn from them that the distribution of colouring matter just referred to as common in old people, follows the same rule in the earlier stages of the fibrosis from dust; but, by degrees, penetrates deeper and more widely, by the medium of the corpuscular elements with which it unites, until large tracts of lung, or even the entire lungs, assume a universal blackness. For black, blueish black or a grey colour prevails, in varying depth, in all examples where ordinary dust is breathed. Zenker's two remarkable cases of inhalation of red oxide of iron offer a striking exception in this affair of colour, the lung tissue in them having assumed the red colour of the dust inspired,—an irresistible proof of the penetration of dust within the parenchyma.

Whilst insisting upon the fact of the black colouration of lungs being caused by inhaled dust, it is right to remember that a black pigmentation may have another origin—viz., in altered hæmatin, as witnessed in melanotic tumours. This was the contention of Virchow, and the late Dr. Warburton Begbie, while not wholly admitting Virchow's hypothesis, was prepared to adopt it in a modified form. This was, 'that when once the deposition of carbon in the pulmonary tissue has taken place to any extent, and the true function of respiration is thereby interfered with, there occurs a tendency which gradually increases to the arrestment of carbon or carbonaceous pigment in the lungs, and its removal from the blood; and that the presence of black pigmentary deposits in the bronchial glands, the pleura, and less frequently the peritoneum and mesenteric glands, makes it probable that there may, in many cases of anthracosis, be some peculiar process of carbonaceous absorption as well as deposition of carbon' (*Glasgow Medical Journal*, 1866).

I have called attention to Dr. Greenhow's excellent essays on lung lesions due to different kinds of dust, as printed and illustrated in the *Transactions of the Pathological Society of London.* But a still better exposition of those lesions is to be found in the unique collection of the morbid specimens themselves existing in the museum of the Middlesex Hospital, and well catalogued. For the convenience of students who would verify facts for themselves, I have quoted the numbers in the catalogue whereby the several examples may be found.

The extent and number of consolidated portions of lung differ in different cases. At times a large portion of a lobe is involved; at others, there are only small masses, or, it may be, scattered nodules (*sp.* 1281). The indurated portions are mostly very dense, cutting like india-rubber or cartilage, with a slight sensation of grittiness. At times, scraping and washing the cut surface will dislodge the black matter and bring into view cut sections of bronchi, and expose a rough, spotted surface, recalling that of a cut nutmeg, as remarked in my essay before referred to.

Associated with these serious lesions,—which really constitute the special features of dust-produced lung disease,—are enlargements of the bronchial tubes, with thickening of their walls, and also enlarged bronchial glands, the true glandular structure of which is transformed into a fibrous tissue of a deep black colour.

Further, the indurated masses show a preference to the apices of the lungs (*sp.* 1274-1278), though they are not uncommon in the posterior and upper portion, and even in the lower lobes (*sp.* 1277-1280). There is puckering of substance in their neighbourhood by fibrous bands, with more or less loose areolar tissue, and emphysema immediately surrounding the condensed patch.

Emphysema is, however, not restricted to the vicinity of the hardened parenchyma, but is met with elsewhere in both lungs, with a partiality to their anterior edges. To a considerable degree this emphysema must be looked upon as of the vicarious form, though, doubtless, some of it is attributable to the catarrh and coughing consequent on the

dust itself. For, as Biermer remarks, hyperæmia of the mucous membrane of the bronchi is attended by swelling, which impedes the evacuation of air from the alveoli and rouses strong expiratory efforts, probably leading to sympathetic reflex contraction. So, likewise, every capillary bronchitis produces either atelectasis when the inspiratory forces are too weak, or over-inflation when these are strong enough.

Merkel (*Handbuch der Hygiene*, 1882) holds similar opinions respecting the emphysema. It is, he says, vicarious (p. 139), and as it proceeds from centrifugal pressure upwards and outwards to the large bronchi and contracted glottis, it is more observable in the upper part of the lungs.

As to the development of a substantive or true emphysema from dust inhalation, his verdict is against it. He, moreover, cannot coincide with Hirt that croupous pneumonia is immediately caused by inhaled dust, although he believes that people employed in a dusty atmosphere suffer in a higher proportion from croupous pneumonia than others.

From time to time the larger patches of condensed tissue seem to undergo a disintegrating process, commencing in their centre, and it is supposable that this may go forward to complete breaking down, and the production of a ragged cavity containing a black grumous matter, such as Dr. Greenhow described in the lung of a collier (*sp.* 1274-1277).

The disintegration may be ascribed to the cutting off the needful blood-supply from the indurated portion of lung; and it is conceivable that a portion of tissue in this necrobiotic state may itself operate much the same as a portion of foreign substance on the surrounding parenchyma.

But, speaking generally, the presence of a cavity in lung lesions from dust arouses a suspicion that we have to do with tubercular complication.

And looking to the surroundings of the suffering persons, exposed as they uniformly are to divers causes of malnutrition, and very often inheriting also predisposition, it is almost a marvel that we can have lesions of the pulmonary organs of such severity without tuberculosis.

Another phenomenon encountered in all cases of dust-produced disease of lungs is more or less thickening of the

pleura and strong adhesions to the ribs, and often some pleuritic effusion. The contraction of the lungs dependent on the fibrous bands in the interstitial tracts, operating further by pleuritic adhesions, will account for the shrinking of the chest cavity, in whole, or in parts, so commonly seen. Dr. Greenhow devoted much attention to a chemical examination of the hard black matter. He incinerated it and boiled the ash with nitric and hydrochloric acids, and found a residuum unattacked by them, which, however, yielded to hydrofluoric acid, and thus proved its siliceous nature.

These results confirmed the researches of Kussmaul, Meinel, Tardieu, and others. By the kindness of Professor Church, formerly Professor of Chemistry in the Royal Agricultural College, I obtained an analysis of the hardened lung of potters, which showed that in 100 parts of its ash there were 47·78 of silica, and 18·63 of alumina and 5·5 of peroxide of iron.

Since 1875, when this analysis was made, experiments have been instituted by several other physicians and chemists, confirming the particulars narrated in all points.

That dust is of very varied constitution is well understood. It admits of obvious division, according as it is of (*a*) organic, or (*b*) of inorganic or mineral origin. The former, again, is distinguishable into animal and vegetable, and the latter into metallic and non-metallic dust. Further, dusts may have very different physical characters, the particles being acicular, or of jagged outline, or oval, or circular; and observation has shown that these minute differences govern, to a considerable extent, its effects on lung tissue and their symptoms.

So great importance did Hirt assign to the form of inhaled dust, that he employed it as the basis for the classification of the dust-producing occupations he examined. His primary division is based on the fact of the dust being inorganic, organic, or mixed. The first-named variety is subdivided, according as the dust is of metallic or of mineral nature, and he then proceeds to form groups, differentiated by the shape of the particles. Dusts of organic and vegetable origin are treated of in the same way, but the plan fails him when animal dusts have to be dealt with.

We are indisposed to employ this principle for classification. It rests upon particulars inconveniently minute and inconstant; and the determination of the form of dust molecules is often indefinite and arbitrary. Thus, it requires an exercise of the imagination to describe the particles of cotton fibre to have a sharp, spicular figure, in the same sense as those of steel or some hard stone.

Besides, it is not to be lost sight of that other qualities of dust particles, besides their shape, play a considerable share in their morbid effects upon tissue. For instance, density is of great importance; and so is the degree of their divergence as regards organisation and chemical constitution from those of the tissues penetrated. Thus, it is seen in the case of lime dust that, notwithstanding its angular form, it is but a feeble irritant to lung tissue.

Another example of the comparative innocuousness of mineral dust is found in alabaster or plaster of Paris in its native state. Its particles have a square or rhomboidal form, with more or less acute angles, but they have not the gritty hardness of siliceous dust, and diffuse readily through water. In this latter respect they differ widely from metallic dust, which, to some extent, seems repellent of water. They, therefore, equally with lime dust, lend authority to the statement that the physical outline of dusty atoms is only one element in their possible action upon lung tissue. Moreover, as will be noticed hereafter, we meet with a peculiar absence of lung mischief among those who work granite, but among whom, on *à priori* considerations, we might well have anticipated great suffering because of the density of the rock.

I would here recall attention to the very practical and useful grouping of dusts suggested by Dr. B. W. Richardson, in his admirable course of Lectures on 'Unhealthy Trades,' delivered before the Society of Arts in 1875-76, p. 129. In outline he distinguished cutting, irritant, inorganic poisonous, soluble saline, organic poisonous, and obstructive and irritating dusts, each form severally constituting a group.

To revert to the primary division I have adopted into inorganic and organic dust, I will make a few observations on the differential characters of the two in connection with pulmonary tissue.

Inorganic or mineral dust departs most widely from living tissue by its natural endowments, and is in no degree assimilable to it, but will remain a foreign substance and a cause of irritation. In other words, it sets up action which must be regarded as a natural effort to get rid of it. The preceding observations on the pathological consequences of dust apply in the highest degree to mineral dust operating as a mechanical irritant. And of such dust metallic occupies the first position in degree of potency for evil. Siliceous rocks and glass follow, and after them sedimentary rocks, pretty much in the order of density and hardness. Coal and charcoal and mother-of-pearl have an organic origin, but mineral matter so abounds in them that they acquire the same hurtful qualities it possesses. The consequences of the dust of the second-named substance are exemplified in Dr. Greenhow's specimen (No. 1203).

Little less injurious results are assignable to truly organic matter in the form of dense woods; as, for example, ebony and rosewood. And in their dusts we have another illustration that physical conformation and density of dust particles are not the sole factors regulating their powers for evil; for experience shows that rosewood, of all other woods, produces the most obnoxious dust. Other vegetable dusts of less potency are flour and starch, which seem to operate rather by obstruction than by irritation.

Animal dusts are evolved by working ivory, bone, tortoise-shell, and horn, but stand low in the list of injurious dusts, and particularly those of the two last named.

Other organic dusts,—some vegetable, other animal,—are encountered in the textile manufactures, and include cotton, flax and hemp, silk, wool, and hair. These, in a general point of view, are obstructive dusts; nevertheless, they are not devoid of irritant properties, and differ greatly among themselves in the latter respect. They further exemplify the fact that, besides mechanical form and action, dust operates by inherent qualities, for that of linen and hemp develops far more serious symptoms.

There is a general resemblance between the symptoms set up by the inhalation of textile dusts and those of ordinary

bronchitis; it remains to pathologists to point out wherein the difference exists; for admitting the difference of causation, we naturally look for variations in the results. Dr. Greenhow contributed to a solution of this problem by his analysis of the bronchial symptoms met with in a flax-worker, published in the *Pathological Society's Transactions*, and, further, by the specimen (No. 1282) submitted to the Society.

This interesting morbid sample exhibited the formation of dense nodules, pathologically similar to those seen in cases of induration by mineral dusts, in physical and pathological features, if not of equal magnitude.

Whatever be the dust, time is the prime element in determining its course and consequences, though structure and special properties count for much. Collateral conditions affecting its results are, constitutional weakness, hereditary proclivity, and hygienic surroundings. Others are the temperature at which the dust is inhaled, the degree of humidity and rarefaction of the air, and the amount of exertion required. These particulars control the diffusion of dust and the activity of the respiratory acts, and consequently the freedom of entry within the air-passages.

Other remarks respecting the constitution of dust will occur in subsequent pages in connection with particular forms, and with the special occupations in which they are found.

Symptomatology of Dust Inhalation.—Of this a general sketch seems desirable. The first feeling is that of irritation in the throat and trachea, provocative of cough. Then follows one of constriction about the sternum, and speedily a desire for fresh air, along with efforts to remove the irritant by coughing and clearing the throat. If exposure be continued, shortness of breath supervenes, with daily cough to expel mucus, the latter displaying, on close examination, the presence of the particles inhaled.

Dyspnœa, in fact, is the most prominent symptom of dust-produced disease, and is often quite out of proportion to the amount inhaled, or the actual alteration of lung tissue. Indeed, shortness of breath may long continue without regard being paid to other symptoms,—such as cough and expectoration, which are mostly confined to the morning

on first rising, and to the time of egress from the warm shop into the outer air. Nevertheless, the dust is in the meantime extending its area of action in the lungs, and progressively embarrassing respiration.

The degree of dyspnœa varies extremely, and is influenced both by individual peculiarities and also by the properties of the dust. Still, the actual lesion behind it affords, in numerous cases, but a partial explanation of its severity. Moreover, if the operation of the dust be exercised over a wide area, extending from the larynx downwards, or over a greater or less extent of the lining of the bronchial tubes, reflex action will be proportionately aroused.

Again, writers generally concur in the belief that a tonic spasm is set up in the bronchial muscles, by the irritation and the reflex action just spoken of, and that co-operating therewith, there is turgescence of the mucous membrane of the bronchi, which interposes a mechanical impediment to the free admission and egress of air to and from the air-cells. This hypothesis is sanctioned by the repeated strong efforts made to inspire and expire.

As indicated before, the nervous phenomena are more pronounced in the case of some dusts than of others; for example, in the instance of flax as contrasted with cotton. A more striking example of what the special qualities of some dusts will cause occurs in the case of ipecacuanha.

When cough is established, expectoration increases. At first the latter is viscid mucus only, but slowly becomes mucopurulent and abundant. The mucus is tinged with more or less colour derived from the dust, which, when long freely inhaled and very carbonaceous, may indeed be present in such quantity as to produce a thick, inky sputum, called popularly 'black-spit.' This deeply-dyed expectoration has been observed in colliers and charcoal-grinders. Colliers, likewise, will at times spit up solid masses or pellets of coal dust mixed with mucus, and friable.

The delay in the appearance of expectoration, especially that of a purulent character and in the form of pellets, is a feature that helps to separate dust-diseased from tuberculous lung. In like manner does the usual absence of hæmoptysis.

When this accident happens, the blood lost is commonly very small. Now and then, indeed, blood-spitting in considerable quantity happens rather early in the malady; a circumstance, it would seem, more common among workmen exposed to metallic dust. On the whole, its occurrence rather points to tubercular complication.

However, when in the final stage of lung induration, a necrobiosis and softening supervene, hæmorrhage in large quantity will occur, together with an abundant expectoration of broken-down tissue. But such instances are certainly rare. Again, lung lesion from dust is not provocative of fever, as is tuberculosis; the pulse is not accelerated until the stage of free purulent expectoration and hectic arrives. Diarrhœa, moreover, is no feature of it, nor is aphonia; and, on the whole, appetite and digestion continue good until the last stage.

Before parting from this subject of symptomatology, it is right to remember that the picture above drawn is conditioned by the presence or absence of intercurrent disease. In fact, intercurrent disease, especially in the shape of an attack of bronchitis or of pneumonia is the rule, and usually accelerates the fatal termination.

The ingenuity of some authors, chiefly foreigners, has enriched our terminology by not a few words, Greek derivatives, certainly not very euphonious, intended to express the kind of dust which is productive of the lung mischief. The general term for the whole series of dust-produced lung disease is pneumokoniosis. If coal or charcoal be the offending material, then the result is a pneumokoniosis anthracitica, or briefly, anthracosis. If metallic dust be the offending material, then there is siderosis pulmonum, or pneumokoniosis siderotica. If stone dust set up the lung lesion, there is chalicosis, and if clay dust, aluminosis pulmonum.

This list does not exhaust the category of barbarisms, the fruit of fertile brains which seem to think a new word is equivalent to the discovery of a new scientific fact.

CLASS II.

Mining and Manufacture.

The occupations comprised in this class exercise their effects upon health in various ways, which I have brought together in eight groups, based upon etiological considerations. They are:—

1. The generation of dust.
2. The employment of noxious or poisonous materials.
3. The evolution of noxious vapours.
4. The action of excessive temperatures.
5. The action of electricity.
6. The action of abnormal atmospheric pressure.
7. Excessive use, friction or strain.
8. Exposure to infection and contagion.

Taking these in order, the first to consider are manufactures producing dust.

Group 1.

Manufactures causing the generation of dust of a non-poisonous character, operating mechanically.—An obvious division of this group is into mineral or inorganic, and organic, each of which may be called an order. A further division of mineral dusts into sub-orders, is to be made according as they are of non-metallic, or of metallic origin. A like sub-division is required for organic dusts, depending upon their origin from the vegetable or the animal kingdom. Further necessary sub-divisions will be made as we proceed. But as was remarked upon in the introductory chapter on Classification, mining will be best treated of in connection with dust-producing occupations. I have therefore assigned it the first place among such occupations as a sub-order of non-metallic mineral dusts.

Order A.—*Mineral Dusts.*

Sub-order.—Non-metallic.—The non-metallic, or in common language, mineral dusts, arise in the operations of (1) mining and (2) quarrying, or (3) in the use of mineral matter in the course of various manufactures.

The business of mining includes two divisions—1, coal

mining, and 2, metalliferous mining. The health features of each of these divisions differ, and call for separate description.

The second department of labour in which mineral dust is copiously produced is what I have termed quarrying. It differs from mining properly so called, by comparatively insignificant features;—the leading one being that in the latter the search for mineral is prosecuted in underground workings, whereas quarrying, in its ordinary meaning, implies open workings, carried on from the surface of a hillside, or a simple excavation. This ground for distinction will not always hold good. For instance, slate is got both by quarrying and by galleries cut underground; and in obtaining alabaster the same thing happens.

The third section of operations whereby dust injurious to health is produced, is illustrated by trades wherein minerals are employed in manufacturing processes; as, for example, in the making of pottery.

But the mineral dust to be at present considered is presumed to be of a non-poisonous character, operating hurtfully by its mechanical action, especially on the pulmonary tissue; an action due to the irritation caused by its component particles, which are generally more or less angular or pointed.

Coal Mining.—The number of men engaged in this occupation, under the provisions of the 'Coal and Metalliferous Mines Acts,' in Great Britain and Ireland, is about 600,000. Of these 500,000 work underground; the rest on the surface. The operations connected with it are very numerous and diverse in character, but all occupied in them get classed under the general appellation of miners. The true coal-getters are those who cut or hew the coal, and are commonly called colliers. Working underground with these are a miscellaneous body of men, some employed in removing coal which the collier has cut away, others in loading the small waggons, 'corfs,' or 'skips,' in which it is carted along the underground roads to the shaft, up which it is to be raised to the surface. As helps to these there are men and boys occupied in keeping the ways or roads open, and minding the doors concerned in the ventilation. Others again have charge of the furnaces, ventilating fans, and pumps, or of the explosives

used in blasting. This list of pit employés, to be complete, would have to be added to largely, but for our purpose a complete enumeration is needless.

At the surface of the mine several other classes of workmen are met with. For instance, those in charge of the engines and winding machinery, those who unload the waggons on reaching the pit-mouth, and those who screen the coal.

This sketch of the work going on in and about coal-pits suffices to show that it varies in health conditions; particularly as regards the two chief divisions; viz., that performed underground, and that pursued on the surface. Those employed in the latter pass under the general name of 'banksmen,' and differ in no decided manner from outdoor labourers, except that they are unavoidably exposed to dust from the coal. On the contrary, the underground workers are placed under distinctly peculiar conditions, though these vary greatly in character in different pits, and parts of pits. For coal-pits differ in geological position, in depth, in the nature of the rock forming the roof and floors of the workings, the amount and quality of gas present, in the quantity of water permeating the strata, in the quality of the coal, its density and dustiness, in the thickness of the seams and their dip, and in the perfection of their ventilation. The influence of these particulars is readily conceivable. A coal, for instance, rich in gas makes working with naked lights impossible and ventilation more difficult, and explosions more possible. A crumbling coal adds to the dustiness of cutting; and a thin seam involves labour of more exhaustive character, on account of the cramped position in which it has to be worked.

It follows, therefore, that data respecting the health of colliers for one district, or even for one pit, compared with another, are not of general application. The force of this conclusion is further enhanced by consideration of collateral circumstances to be found in the varying character of pit populations and of their lodgment; according as the pits are in rural or urban areas.

These qualifications to general conclusions become apparent in purely statistical inquiries. Thus we see that Dr. Ogle, when handling the vital statistics of coal miners,

establishes six groups according to the locality of their work, and his figures make it evident that there are various accidental circumstances in and about the business of coal-mining that materially influence its consequences to life.

The dust from coal-getting displays itself unmistakably upon the person and clothes of the miners, whose black faces resemble those of chimney sweeps. The extreme fineness of the dust diffused in pit workings is shown by its liability to take fire and cause explosions, for these are not exclusively attributable to gas. The immense modern improvements in pit ventilation have reduced both gas and dust to a practical minimum; still both remain, and the underground workers necessarily breathe some proportion of both. The inspired dust, as stated in a previous chapter, enters within the lung tissue, colours it both superficially and deeply in proportion to the amount and the duration of its inhalation, and provokes subinflammatory lesions ending in fibrosis, and marked by symptoms of chronic bronchitis and by dyspnœa.

Ventilation is the primary remedy for removing dust and deleterious gases. The last are generated by slow combustion of the coal in contact with air and moisture, and also, at times, by that of shales containing sulphuret of iron, when sulphuretted hydrogen becomes an additional component of the deleterious gases. But ventilation leaves other underground conditions untouched. Of these darkness is the most palpable, and one not entirely without effect on the health of the body. It entails artificial illumination got by the use of lamps and candles, which, it is hoped, will ere long be supplanted by electric lighting. Lamps have the disadvantage by their combustion of adding to the effects of pit air by their waste products, chiefly by their smoke. Another evil to contend with is the inflow of water into the workings, bringing with it all the consequences to the men of wet clothes and feet, and of chills, and therewith the frequent setting up of rheumatism and bronchitis, or even pneumonia and pleurisy. Few miners long escape rheumatism in some shape; mostly as lumbago and sciatica. Another incident is, that the air of pits becomes fouled not merely by the breathing and exhalation of a hundred or several hundred men and boys, who spend nearly a third of

the day in them, and of a certain number of horses kept in underground stables; but, in addition, by their excreta, which progressively accumulate and mix with the detritus on the floor of the passages.

A high temperature prevails in most pits, dependent upon their depth, the degree of perfection of ventilation, the intricacy of their workings, and the existence of cross roadway, and blind alleys, or *culs de sac,* and upon the temperature of water which enters. There is a direct relation between the heat of a mine and its depth, but the excellence of ventilation exercises a greatly more powerful influence upon temperature than does the depth of a mine. Again, the degree of heat varies to some extent according to the character of the coal worked, and the extent of the chemical influence of air and moisture upon it, which set up a kind of slow combustion. Heat, moreover, is generated by the incessant movements and friction of the superjacent and subjacent layers of mineral, consequent on the removal of the coal. Indeed, combustion now and then grows so active as to fire a pit and to cause explosions.

The consequence of high temperature, particularly when in conjunction with confined air and bad ventilation, is excessive exhaustion. To obviate sweating, colliers will strip themselves to the waist, and thereby become easier victims to cold draughts and to wet, with their outcome in the shape of rheumatism, or of acute chest attacks.

A yet further tax upon the health of the body at large, and upon the respiratory functions, presents itself in the unnatural and constrained positions in which miners often work; thus a very common one is to lie on one side with the legs drawn up, whilst with one hand they use the pick to hole out the coal above and beyond them.

Another health factor, though of less moment, exists in the increase of atmospheric pressure, according as the lower levels are reached. This augmented compression of air is stated to never surpass one-tenth of an atmosphere; yet this much is not without effect upon the respiration and circulation.

The air of coal-pits is always charged with more or less moisture, and with a larger or smaller proportion of irrespirable

gases, and consequently with a deficient supply of oxygen for the exigencies of respiration. As stated before, some pits are always, and others occasionally, very wet owing to the position of the seams of coal and the character of the intervening rock; and at times the inflowing water has a high temperature.

Lastly, the employment of explosives is another incident fouling the air of mines. Formerly gunpowder was in universal use; but chemical science has introduced numerous other substances of greater energy for blasting, such as dynamite and its co-generic derivatives from guncotton. On account of the danger of explosion from the use of these substances, a vast amount of ingenuity has been expended to avoid flame when they are fired. But when this end has been accomplished, the miners will still have to contend with the gases evolved by explosives. The older race of miners are convinced that the newly-invented explosives are more poisonous to them than gunpowder; that they are more suffocating, productive of a degree of unconsciousness, and of severe pains in the head with vertigo and confusion of mind.

The air of coal-mines has been a subject of research on the part of several writers. Dr. Angus Smith published his results several years ago, but the most recent we have met with are those of Dr. Nasmyth, which appeared in the *British Medical Journal* for August 1888. Excellent as these are, they cannot be recognised as applying to coal-pits at large; for, as already noticed, no two pits are precisely alike in geological, mineralogical, and general conditions; and it is a well recognised fact that the mines of the North of England, where he experimented, are far less dusty, and, at the same time, more readily ventilated than those of the Midland counties and of South Wales.

Reflection on the conditions of labour in coal-mines, as now somewhat fully set forth, suggests much sickness and a high death-rate among those engaged in it. Statistics, however, do not confirm this impression; for, as we shall presently see, coal-miners have a remarkably low mortality, although in the matter of diseases of the respiratory organs their death-rate is high.

There is a widespread belief at the present day that the serious lesions of the lungs associated with the calling of coal-getters, belong to past history, or, at the most, are very uncommon; and no doubt can exist that, compared with the past, they are becoming rarer; thanks to the introduction of efficient ventilation, of shortened hours of labour, and of the increased attention given to the hygiene of mines.

Nevertheless, that they do happen, distinct evidence is afforded by the admirable series of specimens bequeathed by Dr. Greenhow, to be found in the museum of the Middlesex Hospital, numbered from 1271 to 1275, and fully described by him in the *Transactions of the Pathological Society of London*. And I can make the same assertion from my own observation, which receives the support of Dr. Totherick, of the Wolverhampton Hospital, and of Dr. Hogben, of the Queen's Hospital, Birmingham, both well placed to express an opinion.

That the lesions are deemed unusual, is due to the circumstance that they are not looked for. Their sufferers enter hospital wards for cough, and get labelled as having bronchitis or asthma, and thus fail to excite pathological interest. By this indifference to pathological research, we are deprived of a full and clear insight into the morbid anatomy of the miners' lungs.

The general pathology of lung lesion, induced by dust, having been fully entered into, it is only necessary to recount here those morbid features peculiar to coal dust.

The general diffusion in lung tissue of the black dust of coal, supplies evidence of the minuteness of the particles. Mostly a considerable time elapses before the lungs take much notice of the foreign matter. The particles are not sharp in outline as in many other mineral dusts, but rather obtuse and rounded, and on this account prove less irritating. However, they are sufficiently annoying to the lining membrane of the throat and bronchi to provoke an augmented mucous secretion, and eventually a cough. This cough is among beginners at the work, especially a morning phenomenon, on first rising; and ranks as a simple clearing of the throat. This is a feature in all dusty occupations. The same thing happens when colliers quit the mine. The expectoration

exhibits spots or streaks, or even small nodules of black dust, and, in more advanced cases, it is black and dense from mixture with deliquescent tissue, and on this account has gained the name of 'black spit.' Happily, like anthracosis itself, this sort of sputum is now rare. It is to be looked for especially among the 'holers' and loaders in mines, who are exposed to the densest dust, and for the longest time.

The effect of coal dust is the production of a catarrhal condition, which advances gradually to chronic bronchitis with great dyspnœa, and ends often in true anthracosis. The pathology of this morbid change is that of fibrosis from other dusts besides coal, as previously described. This sequence of events is not without exceptions, for neither marked bronchitis nor black sputum has always been discoverable where anthracosis has been detected after death. The black colour of lung invaded by anthracosis gave rise to the term *melanosis*, and to the confusion of it for a time with the genuine lesions of that name having a malignant nature. Afterwards, to rectify this error, the name of false melanosis was applied.

The extent to which anthracosis may run is well shown in an excellent paper, published in the *British Medical Journal* for 1857, by Mr. Cox, formerly of Wigan, 'On the Diseases of Miners.' In two cases (he writes), the whole lung tissue looked as if 'steeped in ink, and a black fluid issued from it whenever an incision was made. The bronchial tubes were likewise occupied with the same fluid.' The presence of coal dust was demonstrated both by the microscope and by combustion.

Dr. Totherick also describes to me an example of black lung which crumbled down between the fingers into a pultaceous mass.

The diffusion of coal dust extends to the alimentary canal, and it is the conviction on the part of colliers that they swallow the dust, and by so doing suffer dyspepsia and constipation. Under this impression, some make it a practice periodically to take an aperient.

Layet asserts that coal dust may find its way to the mesenteric glands, and Soyka relates a case (*Präger Medicinische Wochenschrift*, p. 312), in which he detected particles of

carbon in the liver, spleen, and kidneys, apparently conveyed by the vessels of connective tissue and the lymphatics as before stated. Lesions of the pleura accompany those of the lung, and their site seems determined by the presence of a denser or larger deposit of dust on the subjacent surface of the lung.

Merkel inclines to the opinion that, along with the minute particles of coal, other molecules may be discerned, looking clear, and of a yellowish brown hue, derived from the colouring matter of the blood. Chemical tests, however, have failed to differentiate between the two.

In the earlier stages of coal-dust disease the particles are to be found in the sputum, in round mucus cells, and in the columnar epithelium of the bronchi. In old cases the dust is no longer visible in the sputum, owing, as Merkel surmises, to its complete extrusion when removable, or to its intimate blending with lung tissue preventing its escape. The latter notion appears the more probable.

Mr. Schafer, in Buch's *Hygiene and Public Health* (vol. ii.), says black sputa are visible after work in mines has been given up for eight years.

It would be a mistake to attribute all the ills miners suffer to coal dust. In the first place, such dust is seldom pure. Though the essential purpose of the miner's work is to get coal, he has, in order to do so, to remove a large amount of rock above and below the coal seam, and in so doing disengages a large quantity of stone dust, which is more annoying to the pulmonary organs than coal dust. The relative proportion of one dust to the other will vary in different pits, and even in the same pit at different times; and in this fact we find an interpretation of divergent statements of writers respecting the effects of coal mining and of the extent of lesions due to it. The interpretation is aided by consideration of the quality of the coal in regard to dust, and of the perfection of ventilation arrived at.

In the next place, the degree of freedom from mineral gases, and the chemical nature of those gases, are circumstances of great weight in modifying the results of coal mining on health.

Moreover, a third factor exerting some influence on the

health is the position of the coal seams. In certain mines, of which most of those in the northern counties are examples, the coal is deposited with considerable regularity; whereas in others the beds are greatly tilted, and, at frequent intervals, interrupted by 'faults'; in consequence, the ways, or roads, are at places rendered very steep, and only to be clambered by bodily exertion. The difficulties of thorough ventilation and drainage are at the same time added to.

It may be affirmed generally of the dyspnœa of old miners, that it is out of proportion to the extent of disabled lung. Its production is not of uniform origin. One cause is the infarction or stuffing of the lung tissue with the foreign matter; another is the bronchial trouble, with its attendant plugging with mucus and the thickening of the lining membrane of the tubes; a third is the greater or less extent of tissue in an emphysematous state; a fourth, active at times, is blood short of red corpuscles; a fifth, cardiac valvular disease, secondary to the respiratory disturbances; and a sixth to derangement of nervous supply, consequent, perhaps, on the enlarged and diseased bronchial glands at the root of the lungs and in contiguity with the pulmonary plexus. At all events, paroxysmal coughing and breathing is a usual accompaniment of pulmonary fibrosis.

There is considerable consensus among pathologists and statisticians that tubercular phthisis is less frequent among miners than other labourers. Dr. Smart is peculiar in holding a contrary opinion, asserting that the group of symptoms popularly called miners' consumption, is true phthisis of tubercular nature. This hypothesis will not hold good. It is opposed to exact investigation of the diseased tissue in many cases of anthracosis, where no tubercles are discoverable, and no bacilli. Certainly, indeed, both may be met with and a true tuberculosis exist; but when it so happens, the tubercular element is grafted upon the cirrhosed tissue, the product of dust inhalation. It is also contradicted by symptomatology. Thus, hæmoptysis is uncommon; consolidation is not, as the rule, confined to the apex, but frequently located about the centre or the base of a lung, and the breaking down of the dense patches is not an ulcerative process, as in phthisis, affecting the whole mass, but proceeds

as a gradual softening from the centre. Moreover, the lesion is not attended by the febrile heat, sweating, rapid pulse, and hectic of phthisis, nor are wasting and debility pronounced until the duration of the lesion has far exceeded the period usual in tuberculosis, nor until the last stage, that of breaking down of the deposited tissue takes place. Another divergent symptom is found in this, that the dyspnœa of anthracosis is far more severe than that of phthisis. In fine, the consumption of colliers is more unlike the tubercular form than what befalls workers in stone, potters' clay and cutlery.

Great attention was devoted by Dr. W. Ogle to the question of the relative prevalence of phthisis and respiratory diseases among coal miners, as contrasted with others occupied in dusty work. With reference to the latter class of diseases he was satisfied that they occurred in a higher ratio. But his opinion was that, on account of imperfect differentiation of miners' lung maladies from true phthisis, many examples of the former are assigned in death certificates to the latter, thus improperly overstating the proportion of deaths due to phthisis.

His calculated comparative mean death-rate for phthisis in the case of miners was only 126, and his conviction is that, were respiratory lesions erroneously returned as phthisis eliminated, the ratio of this malady would be reduced to the level it occupies in the case of fishermen and farmers, who stand lowest in the scale of sufferers with consumption. According to the public returns, 'The mortality figure of coal miners from phthisis is some 43 per cent. below the average for all males. But so also, or nearly so, is their mortality from diseases of the nervous system;' moreover, under other headings a similarly small mortality is also the rule as regards those labourers. But however the fact be explained, no question exists, 'that the mortality of coal miners from phthisis is remarkably low, especially when their liability to the irritation of the lungs from dust, and the alternations of temperature and other conditions to which their work subjects them, are taken into account. This singular immunity of coal miners from pulmonary phthisis has given rise to much speculation; and the one most favoured is, that coal dust exerts something like a specific

action opposed to the development of tubercles. Both Hirt and Merkel incline to this hypothesis, and Dr. Ogle considers it not impossible it may prove the true one, though, as yet, the data in hand are hardly sufficient 'to establish the conclusion beyond all possibility of fair doubt, and there are certainly some facts which must make us, at any rate for the present, hold our judgment in suspense. For instance—(1.) There is an uncertainty whether the immunity in question is really greater than that they exhibit in regard to other diseases, and not merely a part of their general healthiness, as picked men physically. (2.) The miners in the North Riding, most of whom work in ironstone dust, present a mortality from phthisis but slightly above coal miners at large, and, in fact, below that of the colliers of South Wales, and with regard to these Yorkshire miners, no other inference is producible other than the picked character of these workmen. (3.) Again, coalheavers, who also inhale considerable dust, do not exhibit an exceptionally low mortality from phthisis. Lastly, as Dr. Ogle points out, where there is, in any industry, an excessive mortality from any one cause, other causes must be to a certain extent thereby reduced. 'A man who is killed by an accident cannot also die of phthisis or other disease. Now, among miners, the mortality from accident is appallingly high; and the mortality from all other causes must be by that fact more or less reduced.' Hence, all things considered, the protective influence of coal dust must be left an open question; and all that can be said with certainty is, that the 'inhalation of coal dust does not seem to increase the liability to phthisis; and that both in this respect, and in respect to its effect in producing disease of the respiratory organs it contrasts favourably with many other kinds of dust' (*op. cit.* p. 52).

For my own part, I cannot accept the notion of the conservative influence of coal dust as such, in warding off tubercular consumption. There are many factors to be taken into account besides the carbonaceous nature of that dust with its hypothetical control over destructive organic change. In the first place, particles of coal are not pure absorbent or antiseptic carbon, but a mineralised form having

its peculiar properties, as it were, crystallised and rendered inert. Again, their action on tissue in contact with them is exceedingly slow, provoking primarily an outflow of mucus on the attacked surface, presently followed by lymph-cells, alveolar plugging, and thickened cell walls, and afterwards the development of those cells in and around alveoli and connective tissue into fibrous tissue, which strangulates the alveoli and bronchial tubes, and remains the sole product of the morbid process. These are phenomena of fibrosis, but not of tuberculosis.

Further, in fibrosis there is not the early breaking down of the newly-formed morbid tissues witnessed in tubercular formation. Not but that softening does occur in fibroid degeneration; still, when it does happen, it begins in the central portion of the mass, and is the result of starvation on account of gradual degeneration and obliteration of blood-vessels. Nevertheless, it may be granted that a softening portion of cirrhosed lung may afford a suitable nidus for tubercular matter originating elsewhere; and that when this happens we may anticipate more serious havoc. This occurrence is well established by clinical experience.

If these views be correct, the doctrine of an inherent property in coal dust antagonistic to tubercular consumption is not needed to explain what statistics seem to show, that colliers are not subject to phthisis in so high proportion as might be imagined, or as exists among many other labourers and artisans.

Additional reasons why coal and ironstone miners enjoy considerable immunity from phthisis, compared with men in other industries, are to be found in the general conditions of life surrounding them. They escape the evils of sedentary work; their hours of labour are shorter than those of many indoor occupations; the circumstances of their employment place a bar to riotous living, except the opportunities they make for it when work is ceased; and statistics show, in fact, that their mortality from alcoholism and its contingent diseases is low. Add to these considerations that they are preserved to a great extent from the inclemencies of weather, enjoy a more equable climate than outdoor workers, and that they

are a well-nourished body of men,—at least they should all be so, were their wages properly applied. They awaken public sympathy largely because of their work under ground; for aversion to darkness is engrained in human nature. Still, there are no decisive facts to prove that work in the dark, *per se*, is of distinct injury to human beings. The horses in pits, who remain for months, and even years, under ground, are fat and flourishing; and miners are seldom under ground above eight hours at a stretch, and not that every day in the week. Besides, we have yet to learn that the six months' darkness falling to the lot of dwellers near the Pole is productive of serious bodily harm. It might be a subject for discussion whether a collier in his pit,—of almost uniform temperature,—is not better off than the farm labourer, who is compelled to work longer hours and in all weathers, and frequently in operations equally laborious with those of miners, if not more so. Certainly, his physical surroundings are superior to those of mill hands and of most people occupied in trades.

Cardiac disease, in the form of hypertrophy and dilatation, follows as a secondary result upon the embarrassment of the lungs by diseases limiting their full action, and is, in the end, a cause of general dropsy. The venous turgescence within the head that accompanies it, is to be looked upon as one cause of vertigo.

Dyspepsia, often severe, is another disorder common among colliers, and some writers would have us believe it to be due to swallowed coal dust. This notion I cannot adopt, and there are ample modes of accounting for dyspepsia to be seen in the incidents of the work. Colliers work under ground for about eight hours, without the definite meal hour secured to artisans above ground, and consequently get no proper meals whilst at work, reserving their appetites for an often unduly abundant supply at the end of the day's toil.

Anæmia has been much insisted upon by several writers as a special appanage of the miners' calling. That it might occur is supposable on account of the length of time colliers are almost daily shut off from the light of the sun, and a consequent etiolation or blanching. But Dr. Paul Fabre maintains that true anæmia is not more common among them

than other workmen, and that a microscopic analysis of the blood proves that the number of blood corpuscles and the quantity of hæmoglobin are normal. He further contradicts the statement that *Ankylostomum* is common among coal miners (*British Medical Journal,* 1887, p. 583). My own observation favours Dr. Fabre's opinion, that anæmia is not a marked peculiarity of miners, though I can well believe it was so formerly, before work was limited by law and effective ventilation provided for.

Now and then I have seen cases of general disturbance of the nervous system, in the form of neurasthenia, the victims of which give enormous trouble both to their clubs and the club doctors. They become unfit for work, but, at the same time, present no definite lesion of any organ. However, it is impossible to say how far their employment is responsible for the condition in question. All that can be affirmed is, that colliers suffer from it more than other labourers.

The comparative mortality and prevalent diseases of miners are exhibited in Dr. Ogle's tables. A striking general fact is the low mortality. Only one exception exists, and that is found in South Wales and Monmouthshire, where 'it is slightly higher than that of all males within the same area; but even here, if deaths from accident be left out of account, the rule holds good; the mortality of the miners from all other causes together is below that of the general male population. Again, if in each case we exclude accidents, it will be found that the mortality of the coal miners only slightly exceeds that of the most healthy class of men in our table, viz., the agriculturists,—that is to say, the farmers, the agricultural labourers, and the gardeners. . . . It has, of course, to be borne in mind that miners are a body of picked men. No very weakly man is likely to take to the occupation; and, moreover, as much strength is necessary, many men who become weakly have to abandon this form of labour for lighter work. On the other hand, the general male population, with which miners have just been put in comparison, comprises the sick and weakly of every sort, and the men who have fallen out of the ranks of all industries. This objection, however, ceases to be of much weight if we compare coal miners with such other labourers as quarrymen

or blacksmiths, who also require to maintain a high standard of vigour;' for, excluding accidents, their mortality is considerably below these two groups of workers (*op. cit.* p. 49).

Both Dr. Smart (*British Medical Journal*, September 1885) and Dr. Nasmyth (*ibid.* August 1888) confirm Dr. Ogle's general conclusion. On my own part, my feeling is that further statistics are wanted fully to justify it. There is not only a singular amount of divergence in the statistics of mortality in different coal-mining areas, but also in those of the relative prevalence of different diseases. The higher death-rate found in South Wales has been already commented on, but between the other coal districts of the kingdom the differences in the comparative mortality figures are sufficiently notable. In Northumberland and Durham it is 873; in Lancashire, 729; in the West Riding, 772; in Derbyshire and Nottinghamshire, 734; in Staffordshire, 929; and lastly, in South Wales and Monmouthshire, 1081. Such differences point to important variations in the accidental conditions of coal mining, for the incidental are everywhere much the same.

The variations in the proportion of different maladies as causes of death in the several districts are equally pronounced. Thus, if we look at the figures for 'diseases of the respiratory organs,' which elevate the mortality of miners most of all, we see that in the Northern Counties they are represented by 122; in Lancashire by 220; in Staffordshire, 260; and in South Wales, 293. Taking circulatory diseases, again, we notice that whilst the comparative figure for all males is 120, it is in Derbyshire and Nottinghamshire slightly less than the half. With respect to diseases of the digestive and urinary organs and of the liver, colliers occupy a more favourable position than other occupations at large.

But there is one functional disturbance to which colliers are especially, though not exclusively, subject; that is, nystagmus. This peculiar loss of control over the muscular apparatus of the eye, which might be called chorea of the ocular muscles, has been variously accounted for. Some writers think it is sufficiently explained by the circumstances in which the work is performed, viz., by the small and flickering flame of safety lamps, and by the variation in the intensity of light the eye is subjected to when the obscurity

of the pit is exchanged for bright daylight. Others attribute it to the position in which many work when cutting coal, and especially when holing out thin layers of the mineral subjacent to ironstone, preparatory to loosening the latter by explosives or otherwise. This position is that of lying on one side, one or both arms being left free to work the pick, whilst the lamp is placed towards the feet of the pitman. At the same time, the head is thrown backward, and the legs curled up towards the body.

It will be at once perceived that in this position the muscles of the eye-ball must be unequally exercised by the upward oblique strain of the eye in cutting the mineral above and beyond the centre of movement of the arms, whilst the light available is small, at a distance, and falls obliquely upon the labourer. This over-exertion of certain of the eye-muscles leads to exhaustion and paresis, and the condition produced is similar, pathologically, to 'scriveners' paralysis.'

This second hypothesis of the causation of nystagmus,—for its production by central nervous disease may be dismissed as a rare occurrence,—appears the more plausible, and was well argued by Mr. Simeon Snell, of Sheffield, in the *Ophthalmological Transactions* (vol. iv.), to which we would refer for a fuller account of the malady. Quite recently this most capable authority has elaborately defended his hypothesis, and illustrated it by cases derived from his own wide experience in a monograph, entitled 'Miners' Nystagmus and its relation to position at work and the manner of illumination, 1892.' I consider it enough for my purpose to thus point out where the theories of causation of nystagmus are discussed without entering myself into the fray. But this I may say, that in the district of North Staffordshire with its large mining population, cases of the disorder are few and far between, so far as infirmary records and the experience of the surgeons of the large infirmary there can tell us.

Dr. Gordon Norrie, writing to the *Lancet* (December 13, 1890), propounds the theory that nystagmus is not of muscular origin, but is either a functional or organic abnormality of the central mechanism of innervation. To illustrate his opinion, he adduces several cases of nystagmus, mostly betraying signs of other nervous derangements, but none of which happened among coal miners,—a class of workmen

unknown in Denmark. My conviction is that the disease in miners, and that collection of nerve symptoms Dr. Norrie remarked in the Copenhagen Hospital patients, are two different maladies; just as observation forces me to believe that the disease called chorea presents two distinct forms,—one of mere functional disturbance, the other of organic central mischief.

Nystagmus will disappear when its sufferers give up pit work; so, in like manner, will simple chorea vanish under altered conditions of life and improved nutrition.

Another evil besetting the work of colliers is the occasional production of contractures of the fingers, dependent upon the perpetual friction, pressure and slight concussions of the end of the handle of the small 'picks' used, on the palmar fascia and tendons.

Miners, as a rule, are not well-set-up men. They have an anxious and depressed expression, prematurely look old, acquire a stooping gait, walk in a shuffling manner, and are frequently misshapen in the limbs. However, these characteristics vary greatly in different coal districts, according to the character of the pits and coal strata, and according to racial peculiarities. There are few colliers who escape bluish black scars on the face and hands, and on other parts of the body exposed when at work.

We have already remarked that the physical and moral conditions of colliers vary according as the mines are situated in the open country, or in or near to populous towns. In the former localities they are largely recruited from the agricultural population around, and lead more steady and sober lives than miners dwelling in towns, whose origin is from among the rougher elements of the population, and who are exposed to all its vices. And notwithstanding the advantages of good wages, these are, in too many cases, not turned to profitable account, the money earned being wasted in reckless and riotous living whilst it lasts, the comforts and decencies of home glaringly neglected, and steady work regarded as an evil to be avoided.

The gravest incident in the occupation of colliers is the liability to accidents. In the public mind the idea prevails that accidents are almost all due to explosions. This is far from the fact. Mr. A. R. Sawyer, late Inspector of Mines, in his

elaborate monograph on *Accidents in Mines*, 1888, remarks in the preface 'that more men are killed by falls of roof and sides than from any other cause, but as they are mostly killed singly, these fatal accidents do not excite anything like the sensation produced in the mind of the public by a fire-damp explosion, and most of them pass nearly unnoticed.' And from his concluding statistics, it transpires that, in North Staffordshire, 'a yearly production of 6,402,782 tons of coal, fireclay, ironstone, and shale entails the loss of 12 lives by explosions, 17 lives by falls of roof or sides, and 17 lives from other causes, as well as more or less severe injuries to 8 persons by explosion, to 126 persons by falls of roof and sides, and to 149 persons from other causes' (*op. cit.* p. 188).

Dr. Ogle's statistical researches led him to corresponding conclusions, and to the further inference that the leading accidents spoken of are shared pretty nearly in proportion to the numbers employed. 'Putting, however, all causes together, it is plain that the lads and younger miners suffer considerably more from accidents than do the older workmen' (*op. cit.* p. 53), a circumstance that may be in a measure assigned to their want of foresight and imprudence, and to the risky nature of the work with the waggons and tubs usually allotted to them.

As a further and valuable contribution to statistics of colliers, I may quote the recent returns of their mortality, made by Dr. Collinette of Silverdale, Staffordshire, the medical officer of that mining district, for a period of six years. The results are thus tabulated:—

	Under 20.	20 to 30.	30 to 40.	40 to 50.	50 to 60.	Over 60.	Total.
Heart Disease, . .	1	3	5	2	7	14	32
Accidents, . . .	4	11	6	8	6	4	39
Phthisis, . . .	1	2	3	10	4	1	21
Bronchitis, . . .	..	...	2	6	11	54	73
Pneumonia, . . .	2	8	9	8	12	7	46
Other Lung Affections, .	...	...	1	2	2	...	5
Disease of Nervous System, . .	...	...	...	3	8	16	27
Cancer, . . .	...	...	...	3	2	3	8
Typhoid fever, . .	1	1	1	...	1	..	4
All other diseases, .	...	3	...	9	10	26	48
	9	28	27	51	63	125	303

These figures corroborate previous statistics generally. They point to delay in the development of phthisis beyond the age usual in the population, and suggest that some at least of those cases registered phthisis were in all probability not tubercular but examples of anthracosis. The remarkable rise in the deaths attributed to bronchitis after the sixtieth year is a fact to be noticed. Bronchitis, considered as a disease of occupation, illustrates the previous remarks as to the length of time it may exist before it becomes fatal; for the principal portion of the cases assigned to it as a cause of death will have been very chronic, and not a few of them instances of lung fibrosis. A real differentiation between phthisis and bronchitis is not a feature of mortality registers.

Respecting the relative prevalence of the principal diseases met with among colliers, I am not myself prepared with sufficiently numerous examples to speak positively on the matter. Among 253 colliers, 37 per cent. suffered with bronchitis; 6·27 with phthisis; 15·5 with gastro-hepatic disorders, and 17 with rheumatic affections. In 3 only out of the whole number were cerebral lesions manifested, and in 1 only was cardiac disease noted.

An actuarial examination of fifteen years' experience of the North Staffordshire Provident Association was made in the past year by Mr. F. G. P. Neison. This society consists about two-thirds of male potters, including a few other working people, and one-third of colliers, and represents the most careful and steady men belonging to those callings.

The result of the investigation respecting the amount of sickness suffered is, that while the potters have fallen below the anticipated rate, the colliers have exceeded it. Of the whole body of members, 5779 were sick, against 6057 expected; whereas of colliers, taken by themselves, 214 were sick while only 145 were expected to claim; the ratio being 148 actual to every 100 expected. On the contrary, as regarded mortality, that of potters stood in the ratio of 83 actual to every 100 expected deaths, and that of miners as 56 to 100. This shows that the mortality of potters greatly surpasses that of colliers, although the sickness of the former is considerably less. The apparent anomaly admits of explanation fairly satisfactory. The business of the potter is less

laborious and hazardous than that of the miner; consequently, when the same amount of illness or accident befalls him and the miner alike, he can sooner return to his labour than the latter. Moreover, the miner suffers a far heavier proportion of accidents; some of which will keep him for a very long period upon the sick-list. And it is necessary to observe that the proportion of sickness is reckoned from the number of weeks members remain on the books, and not on that of individual cases of sickness. But be the interpretation what it may, the fact remains that the association suffers by the high ratio of sickness among those of its members who who are colliers.

Coal-heaving, coal-trimming, and chimney sweeping are other occupations in which the dust of unburnt or of burnt coal plays the part of a cause of sickness.

Coal-heavers are generally understood to include the rough labourers engaged in loading and unloading coal vessels, or on coal wharfs in filling sacks and other miscellaneous work giving rise to coal dust. Coal-trimmers are more unfavourably placed by reason of their work being carried on in the holds of vessels; its purpose being to equally distribute the load of the mineral so that the ship may be trim when afloat.

Such workmen require the possession of a good physique, and should present a low rate of mortality. Unfortunately, this anticipation is greatly thwarted by the habits of intemperance common among them; nevertheless the comparative mortality figure of coal-heavers is, as calculated by Dr. Ogle, only 968 as contrasted with 967 for occupied males generally, and 1000 for all males. It is, however, higher than that for coal-miners. Turning to the causes of death as set forth in Table K (*op. cit.* p. 31), it is seen that diseases of the nervous system are accountable for 10 per cent.; diseases of circulation for 12·6, phthisis for 21·7, respiratory affections for 20, urinary and liver each for 3, and 'other diseases of the digestive system for 6 per cent, and, lastly, alcoholism for 1·3 per cent.' 'Putting (writes Dr. Ogle, *op. cit.* p. 56) phthisis and diseases of the respiratory organs together, coal-heavers would appear to have a liability considerably above that of

coal-miners, but not far from the average of all males.' He adds, they are very liable to accidents, but not in anything like the same degree as miners.

Chimney Sweeps are a class by themselves so far as concerns the active cause of disease existing among them. In the chapter on the 'conditions of labour,' we have cited sweeps as a class of labourers who suffer physically and morally by the social position allotted them. They are to a certain degree Helots of society, placed under circumstances inimical to their social well-being and their health; and, from this cause, apart from the peculiar incidents of their occupation, we might expect them to occupy an unfavourable position in tables of comparative mortality, and such we find to be the case. Thus Dr. Ogle says their death-rates between the ages of twenty-five and forty-five, and also between forty-five and sixty-five, are excessively high, and their 'total mortality, as shown by their comparative mortality figure (1519), is 50 per cent. higher than the average' (*op. cit.* p. 56).

As to causes of death, the Table K indicates no marked difference between those prevailing among coal-heavers and sweeps. Those of the circulatory system are somewhat rare, and those of the digestive organs decidedly so. Phthisis and respiratory maladies stand much on a par in the two trades; the latter in a slightly lower ratio. But, in the matter of alcoholism, sweeps show a greatly higher percentage than coal-heavers; that is, as 2·06 to 1·3 per cent.

Moreover, sweeps are often troubled with skin (eczematous) eruptions, and their eyes suffer with the acrid soot, making them blear-eyed. It seems demonstrable, moreover, that the soot finds its way into the subcutaneous tissue, where it produces small patches, not removable by washing. From these the black particles can, it seems, make their way along the lymphatic spaces to more distant localities. (See remarks by Mr. W. G. Spencer, *British Medical Journal*, November 15, 1890.)

But the disease, *par eminence*, attaching to their calling is epithelial cancer. Dr. Ogle discovered, from his statistics, that 'of 242 deaths of chimney sweeps, no less than forty-nine

were due to some or other form of malignant disease. This gives 202 deaths from this cause to 1000 deaths from all causes; whereas the proportion of deaths from malignant disease to deaths from all causes, among all males from twenty-five to sixty-five years of age in England and Wales, is only thirty-six in 1000; so that, even if the total mortality of sweeps were simply equal to that of all males, their mortality from malignant disease would be more than five times as much as the average. But the mortality of chimney sweeps . . . is 50 per cent. higher than the average, so that the liability of chimney sweeps to malignant disease is about eight times as great as the average liability for all males. These figures scarcely support the belief expressed by some authorities that improvements in the art and habits of sweeps have caused this disease to be comparatively infrequent among them.' Of the forty-nine cases of deaths by cancer returned, the scrotum and adjacent parts were the seat of the lesion in twenty-three; in thirteen the organ affected was not stated; but in seven of them the malady was in internal organs, and the rest in the face, hip, orbit, palate, or neck.

The consoling belief that sweeps' cancer is becoming a scarce phenomenon, since the application of the special Acts of Parliament controlling their work, is also somewhat rudely shaken by Mr. Butlin, of St. Bartholomew's Hospital, who, in his work on *Cancer*, affirms that numerous instances are to be met with.

Group 2.

Metalliferous Mining.—The incidents of this occupation differ materially from those of coal mining, excepting where coal and ironstone occur together, as they do over large areas of this country. Where this happens, there is a frequent interchange among the workmen, who leave one employment for the other, and in many general features the two occupations bear a resemblance. However, the miners regard *ironstone getting* as more injurious to themselves, both by reason of the character of the dust and the presence of what they call 'sulphur,'—some gaseous product not determined. For ironstone gives off no gases like coal,

and if any gas be generated it is sulphuretted hydrogen developed from the iron pyrites by the action of water and of the atmosphere. As a set-off to the greater evils of the dust and of the harder labour of cutting the ironstone, the men have the advantage of not being exposed to explosions, though these disasters are not wholly unknown in ironstone pits where coal and ironstone occur together. It is usual to find the seam of iron overlying a thin one of coal; the latter has to be 'holed' out, and this done, an explosive is used to break down the layer of ironstone. The consequence of this operation is considerable dust and the diffusion of hurtful gases from the explosive used. As the denser nature of the iron ore requires a larger and more frequent use of explosives than does coal, it is probable that more irrespirable gas persists in the workings, which, moreover, are, as a rule, less thoroughly ventilated than those of coal mines, and that it is from these circumstances conjointly that the miners find ironstone cutting worse to health than coal-winning, and get the notion of the presence of some sulphur-bearing vapour.

Another difference in favour of ironstone working is, that not only is the danger of explosion vastly less, but also that of other forms of accident that abound in coal-getting. Where ironstone and coal mining go on in the same locality, where the getting of iron ore necessitates more or less coal-hewing, and where, as before said, men transfer themselves from one form of labour to the other, it is almost impossible to collect data which apply solely to this or to that kind of work. Dr. Ogle finds iron and coal miners occupy the same favourable position as regards the development of phthisis; but in the matter of diseases of the respiratory organs, viz., chronic bronchitis and asthma,—the ironstone men exhibit a greater prevalence. This fact corroborates the impression existing among the men themselves, and which also my experience confirms, viz., that ironstone mining causes severer bronchitis and asthma than does coal-getting, and is altogether a more unhealthy employment.

It should not be forgotten that ironstone is not always worked deep under ground along with coal; but that in some districts, where it occurs in the form of hematite, the

ore is reached by shallow pits or excavations. In such places it is evident the conditions of labour depart materially from those seen in coal mines, and are less unfavourable to health.

Tin, Copper, and Lead Mines.—The recovery of *metallic ores, other than those of iron,* from the bowels of the earth, differs in numerous particulars from coal-mining. As these ores are not like coal and most ironstone, deposited in strata or seams, which follow general laws of distribution, they cannot be reached by similar workings. Occasionally the vein of ore, or the lode, can be reached by cutting more or less horizontally into a hill-side; but, more frequently, shafts are sunk vertically to reach the deposit, which has then to be followed along its more or less erratic course. There is, therefore, no regular system of roadways, with frequent intercommunications, as found in coalpits; the 'lode' followed will run out, or perhaps end in a *cul de sac*; whilst ventilation by furnaces, fans, and valve-acting doors is little practicable. However, metalliferous mines have the advantage over coal mines of not generating the like poisonous and explosive gases, and therefore can be almost always worked without danger by naked lights.

Metalliferous mines, again, by their irregular galleries, levels, adits or passages, their very defective ventilation, and their frequently great depth from the surface, are very hot—the heat increasing according to depth, and the difficulty of carrying fresh air to their distant parts. The same obstacles that beset ventilation also stand in the way of removing the water which finds its way into the workings on all sides, and compels the miner to labour standing in water and besprinkled by it in various directions. And though he can work with a naked light, a candle, or an oil lamp, his working space is often so narrow and confined, and so out of reach of fresh air, that he is compelled to inhale the abundant smoke given off, mixed with the limited amount of air allowed for breathing purposes, deteriorated as it is by his own breath, and occasionally by some carbonic acid escaping from the rock. Lastly, these several evils are aggravated by the employment of explosives, which both generate poisonous gases and dislodge more or less rock, with the inevitable accompaniment of dust.

It is therefore very evident that, in metal mining, there is a distinct group of morbid factors; to wit:—Want of fresh air, the presence of dust and smoke, unnatural heat, exposure to wet, fatiguing positions of the body, and heavy labour. In connection with these circumstances it is necessary to remember that the miner cuts his way through tortuous passages, and, to save labour, makes these no larger than necessity demands. Another incident, seen chiefly in copper and tin mines, is the use of ladders to reach the workings below. These are placed very vertically, and, besides the labour involved in ascending and descending by them, are a source of danger. Those accustomed appear to do the climbing with facility; nevertheless, the labour requisite throws a great amount of strain upon the heart and the action of the lungs. Still, if we may trust statistics, the proportion of cardiac affections, although high, does not equal that calculated for occupations in general; figuring as 111 to 120. Nor, again, can the labour accruing be considered greater than that falling to the lot of sailors in climbing the 'shrouds' of ships. To lessen it various ingenious mechanical contrivances have been invented to take the place of ladders.

The amount and quality of the dust, and the outflow of water in excavating the ore and cutting the levels, will differ according to the composition of the rock, its water-bearing properties, the position of the working place relative to the line of stratification, and the presence or absence of fissures through which water can percolate. The last-named, at times, give exit to such an abundance of water as to drown the workings. It is especially in the mountain limestone formation that fractures and fissures of the strata occur, and which sometimes assume the dimensions of caverns. Hence it is that lead-mining has been, to a great extent, extinguished as a profitable business in Derbyshire and other like limestone districts. It goes without saying that, where moisture reigns around, there will be less dust in the operation of mining; and experience shows, moreover, that in moist mines the smoke from explosives disappears sooner, either by absorption, or rather by adhesion to the wet surface of the workings, than in dry mines.

Metalliferous mines are worked by the aid of lamps or candles. In the confined working-places, with stagnant air, the smoke of the lamps assumes high sanitary importance, and we read of embarrassed breathing, and of lungs eventually blackened by the soot.

This discoloration of the lungs, however, is attributed, at least in part, by Brockmann, whose experience was gained among the copper miners in the deep pits of the Harz mountains, to hypercarbonisation of the lungs, depending upon deficient oxygen in the air breathed, and to the great excess of carbonic acid present, and, in some measure probably, to the almost purely vegetable diet of the miners, coupled with indulgence in alcoholic drinks. These circumstances, he urges, concur primarily to render the blood dark and venous, to arrest carbon in the pulmonary tissue, and to produce browning of the skin; and as secondary consequences, loss of strength, wasting, dyspnæa with some cough and coloured sputum; a group of pathological phenomena Brockmann styled '*tabes metallurgica.*' The after-death appearances recorded are:—Black staining of the pulmonary tissue, fatty heart, serous effusion into the pericardium, red, and sometimes yellow, atrophy of the liver, with melænic patches; engorgement of the portal vein, blackness of blood, atrophy, softening and black discoloration of the spleen. The cerebral substance appeared normal.

The dust of copper ore is credited with the production of severe gastric troubles and intestinal disorders, and Brockmann speaks of a scurvy-like affection of the mouth, sometimes extending downwards to the stomach, in the form of ecchymoses, petechiæ, and superficial hæmorrhages. This disturbance of tissue-nutrition may be reckoned a consequence rather of the wretched and samely food those foreign miners existed upon, than of the character of the work followed; for English writers make no reference to such special lesions, although they note the frequency of dyspeptic conditions.

Dr. Wood, of Wirksworth, Derbyshire, says (*British Medical Journal* 1857, p. 687) the lead miners of that district are well fed, but become pallid from the hot, confined air of the mines, and the want of proper oxygenation of the blood. The same causes produce headache, lumbar pain, difficulty of breathing, general prostration, and debility;

whilst the wetting from inflowing water frequently sets up acute rheumatism and its after consequence in the shape of heart-disease, as well as the local and often chronic forms, lumbago and sciatica. Yet, with all these evils of their employment, Dr. Wood regarded them as healthy, long-lived people; favoured by hygienic external surroundings, usually comfortable homes and temperate habits.

How greatly these accessory conditions do affect the hygienic results of the occupation, is well illustrated by the account given of the lead miners of the East Riding, furnished by Dr. T. H. Jackson, of Richmond, Yorkshire, and published in the same journal. Here, instead of the more sylvan scenery of Derbyshire, were a bleak moorland, rocky country, small wages, poor food, and overcrowded lodgings, and a mean average of life of from forty-five to fifty years.

In the great mining region of the South-Western States of America, Nevada, Utah, and Colorado, special physical conditions prevail. The miners exist in an outside rarefied air, at 5000 to 13,000 feet above sea-level, and when at work at great depths, endure a high barometric pressure and temperature. In Buck's *Hygiène* (vol. ii.) the conditions of labour in the Comstock mine of Nevada are cited. Here the lower working levels are some 2000 feet 'below the usual datum line,' have a temperature of 130°, and are percolated by hot water, as high at times as 154°. But the mine is well ventilated by tubes, which carry in air at a temperature of 95°. With a temperature of 108°, the men can work for eight hours together; but the heat and atmospheric pressure give rise to a feeling of distress, and to a labouring heart.

The miners acquire a waxy colour, and often have heart-disease, typhoid and mountain fever, rheumatism, and erysipelas. 'There is little or no consumption, bladder, kidney, or liver disease.'

This recorded absence of consumption in American mines is a noteworthy fact; because, in England, no other occupation gives so large a mortality figure from that malady as does metalliferous mining. For after allowing for the advantages to health admittedly present in mountain regions, the statement made is, to say the least, extraordinary.

Here it is well to introduce the extended and painstaking investigations of the late Dr. Headlam Greenhow, carried out for the special purpose of elucidating the causes of the prevalence of chest maladies among miners and others.

(See *Papers relating to the Sanitary State of the People of England*, London, 1858), Dr. Greenhow wrote thus:—'There is no class of places in which the influence of occupation on health is more powerful, or so evident, as in some of the mining districts. Mining operations are frequently pursued in situations naturally salubrious, and generally more or less removed from great cities. In many cases, the little centres of population that spring up in mining districts are exclusively inhabited by miners and their families, and the classes who minister to their wants. Hence the influence of the prevailing occupation on the health of those engaged in it is proportionably evident.' Females may be left out of the question, as the number of those employed is insignificant in relation to the total number. 'The influence of certain kinds of mining on the health of miners is, therefore, rendered additionally evident by the difference in the male and female death-rates of the same places, and the direct relation that exists between this difference and the proportion of men employed in the mines' (pp. 61-62).

The unavoidable conclusion was, that the exceedingly high death-rate among metalliferous miners was owing to their employment.

We may here reproduce Dr. Greenhow's own arguments. He takes Alston and Reeth in Yorkshire as affording the clearest examples of towns wherein lead mining is the almost exclusive occupation for males, and presents in a table the death-rates at all ages of the population from all causes, distinguishing males and females under five years old; then, in a parallel table, he quotes the death-rates from pulmonary affections, and compares the results with those for the neighbouring healthy agricultural district of Haltwhistle.

From the data thus obtained, he calculated that the mortality of children under five years old, from all causes, was but little higher than that in Haltwhistle; whilst that from pulmonary affections was much higher, yet very far below what existed in Liverpool. 'This advantage enjoyed

by the younger inhabitants of the lead-mining districts over those of Liverpool, is altogether lost in more advanced life. The women of Liverpool perish from chest affections in a rather larger proportion than those of Reeth; in a slightly lower proportion than the women of Alston; but the men of Alston and Reeth die in a much larger proportion than the men of Liverpool. Thus a district remote from city influences, situated in the midst of a most salubrious district, and containing scarcely an appreciable urban character, loses an annual larger proportion of its adult male inhabitants from diseases of the chest, than the unhealthiest city in the kingdom. That this is due to the nature of the prevalent employment, no doubt can be entertained. . . . Alston has been a lead-mining district for many centuries, and the inhabitants have probably acquired some of those peculiarities of physical character to which the term race may properly be applied. Amongst these peculiarities, a tendency to pulmonary disease must probably be included, and hence the greater proportionate mortality of women and children from such diseases in Alston than in places which approximate to it in character in all respects save the occupation of their inhabitants. Certain it is that lead-miners and coal-miners are, in the North of England, readily distinguishable by their aspect, both from each other, and from the rest of the world, by persons conversant with their appearance. It is not unimportant to observe that the majority of the men of Alston who die of pulmonary diseases, are returned as having died of asthma.'

Heart disease is spoken of as very common among the Cornish miners; Dr. Greenhow, however, was unable to satisfy himself of the truth of this opinion.

Upon this point we may turn to Dr. Ogle's tables, from which it appears that the ratio of diseases of the circulatory system is decidedly below that for all males in England and Wales—viz., as, 111 to 120. On the other hand, the mortality figure for phthisis exceeds that attaching to any other occupation recorded, being 690, as contrasted with the normal, 220. Respiratory diseases follow next, represented by 458. There is also an excess of mortality from diseases of the nervous system and the digestive organs. The latter

stand at 56 instead of 38. With regard to other maladies, these miners present no very prominent peculiarities; but their comparative mortality figure surpasses that of all classes in the population, except those returned as 'costermongers, hawkers, and street sellers'—that of miners being 1839, and that of the last-named group 1879.

It must be observed that Dr. Ogle deals with Cornish miners as one group, without distinction of the form of mining pursued. Again, the startling proportion in which phthisis figures as the cause of mortality cannot be accepted as entirely correct; for, in this class of workers especially, the returns made of the causes of death are seriously vitiated by the popular nosology, which, as Dr. Greenhow points out, assigns the majority of the deaths of miners to consumption, a term which, in the hands of registrars, will be often transformed into phthisis; whereas in a true pathology the fatal lesion should be entered as pulmonary cirrhosis or fibrosis; nevertheless, this conclusion, it must be admitted, is a matter of inference from symptomatology, and not of demonstration by autopsies which the prejudices of Cornish miners forbid.

These remarks on the difficulties arising in the search for the real incidental evils of an occupation, may be extended and applied towards the solution of the debatable question as to the prevalence of heart-disease among Cornish miners. It has been seen that Dr. Ogle, from his analysis of the causes of disease registered, arrived at the conclusion that cardiac affections among those workmen are under the average found for the whole male community. Now, considering the heavy labour of copper and tin miners, who work at great depths and in very impure air, and have to ascend daily to the surface by means of ladders, it would naturally be inferred that the great strain upon the heart would produce lesions of that organ. That this actually happens was the belief of Dr. Peacock, who made inquiries upon the subject, and who was so well versed in cardiac pathology.

Why the statistics of the Registrar-General do not confirm this opinion may, it seems to me, be partially attributed to imperfections in the registration of the causes of death. It is known on all hands that the malady which ought to be

returned as the cause of death is frequently disregarded, and represented by some series of symptoms which have cropped up as secondary consequences, or which by their greater prominence, or by their onset shortly before death, have arrested most attention. And often a serious lesion is masked by others, or else complicated by others, and it becomes a question to which of them to assign the cause of death.

Now, it appears to me probable that whilst the presence of the unmistakable symptoms of consumption, and the prevalence of that among Cornish miners, secure it a place in mortality returns, cardiac lesions by their less prominence fail to be registered. If right in my supposition, I am not prepared to accept the conclusion as to the infrequency of heart diseases among metalliferous miners, which the returns of the Registration Office seem to sanction. One observation more in favour of the belief in the greater frequency than recorded of heart diseases among tin and copper miners, is found in Dr. Greenhow's statement that anasarca is more common with these labourers than with lead miners; for anasarca may be fairly attributed in a majority of cases to heart-disease; and if cardiac maladies are less usual among lead miners, we get an explanation from the fact that the work is less favourable to its production, by reason of the comparative shallowness of lead mines and the absence of ladder climbing.

Sub-section A.—Lead Mining presents peculiarities of its own, both in respect of the ore extracted, and of the circumstances attending its extraction. It is, moreover, found for the most part in limestone formations; whereas tin and copper abound chiefly in primitive rock formations, and are followed to very much greater depths from the surface. Again, lead has distinctive poisonous properties, though very slightly pronounced when in the form usually mined, that of galena, or the sulphide of the metal. In fact, the insolubility of this native salt argues powerfully against its being a source of plumbism among those who mine it; but the evidence of Drs. Jackson and W. Webb, who practised among the lead miners in Yorkshire and North Derbyshire respectively, cannot be gainsaid (see *British Medical Journal*, 1857, p. 619 and p. 687).

Besides these authorities for accepting the fact, evidence is afforded by records of the occurrence of lead poisoning among those engaged in washing and sorting galena after it has been raised from the mines; and, likewise, by the circumstance that fish cannot live in streams polluted by the washings.

My own inquiries among men mining galena are confirmatory; and it is quite conceivable that its powers to poison may differ in different mines, not only from slight variations in the chemical composition of the ore itself, but also from differences in the rock connected with it, and in the water which streams from it;—circumstances possibly operative at times in imparting greater solubility to the contained mineral or otherwise bringing its poisonous qualities into activity.

Dr. Greenhow gave a copious account of lead-ore mining in the *Third Report of the Medical Officer of the Privy Council,* 1860 (pp. 135 *et seq.*), based chiefly upon data furnished by the health history of Reeth, where that occupation is almost exclusively followed. He compares this small town with the normally healthy neighbouring district of Glendale, with the result that 'whilst the mortality produced by pulmonary affections during the first fifteen years of adult life is rather higher in Reeth than in Glendale, the divergence increases as life advances, until the men of Reeth die four times as fast from these diseases as those of Glendale. between the ages of forty and fifty, and five times as fast over fifty years of age.' The women also of Reeth exhibit a high ratio of chest complaints. His next business was to discover the causes of this heavy death-rate from pulmonary maladies, other than those attributable to mining. Among others he pointed out that marriages of consanguinity and scrofulous affections were common, and that a marked deterioration of race was in progress. But besides these conditions, he considered that not only intermarrying, but the marriage of men when already suffering chest affections, and who continued to procreate children during many succeeding years, must be taken into account. Yet although in these particulars males and females stand alike, 'the wide divergence of the male and female death-rates from pulmonary diseases

evidently indicates the operation of some special conditions upon the health of the male population, from which the female is exempt,' and which, beyond dispute, exist in the business of lead mining.

Lead mines are less generally worked by perpendicular shafts than formerly; levels, where practicable, being driven in from the side of a hill, in a horizontal fashion and often parallel to one another, with intercommunications by vertical shafts. The strata cut through are usually limestone, sandstone, or shale. Those burrowed in limestone are the most wholesome, the most readily ventilated, and the most free from dust. Those in shale are the most dusty, and occasionally their atmosphere is vitiated by the escape of gas; for the most part, carbonic acid, or 'choke damp.' Inflammable gas is not met with, unless the rock be shaly. Most of the work in those mines is done by blasting; manual work being chiefly expended in boring for the reception of the charge. The greatest evil, as far as health is concerned, arises from the smoke of explosives and of the lamps, and from disengaged dust.

How great differences in sanitary results may obtain between different mines is exemplified by Dr. Greenhow's notes, which showed that in one pit the duration of life and freedom from disease was greatly more favourable than in the other (*op. cit.* p. 142), the degree of perfection of ventilation being the main determining cause of the divergence. Turning to the development and course of pulmonary diseases consequent upon lead mining, we encounter the like symptoms to those of other dusty occupations which need not be re-counted anew. The urgency of the symptoms and the rapidity of their development stand in direct ratio to the healthfulness of the mines and the habits and surroundings of the miners. At all times, there is a proneness to catarrhal and acute inflammatory seizures which hurry on the destructive lesion. Hæmoptysis is not frequent, though as a symptom it varies in different localities. No statement as to the age at which asthma manifests itself, or inability to continue work happens, can be generally predicated. As Dr. Greenhow remarks, at some mines the oldest survivors in health were not more than from forty-eight to fifty-two; whereas at others, men above sixty, and two or three at seventy,

were able to keep at work. So with regard to the onset of asthma, in one mine all the men became short-breathed before forty years old; in another not until after the age of fifty.

Sub-section B.—Copper and Tin Mining.—The getting of copper and tin is, in Dr. Greenhow's opinion, less pernicious to health than lead mining, although the work is carried on at greater depths, and consequently with greater exposure to heat and bad air. In the following extract from Dr. Greenhow's *Report* (*op. cit.* p. 64), the lead miners of Alston are compared with the tin and copper miners of Liskeard, Penzance, and Redruth; statistical tables being adduced in illustration. 'Redruth has a slightly smaller proportion of its men employed in mining than Alston, and a larger proportion than Reeth; its inhabitants are much more densely aggregated on the surface of the soil than those either of Alston or Reeth; a larger proportion of its men are engaged in agriculture than of the men of Alston, a smaller proportion than those of Reeth; but its male pulmonary death-rate, both for the whole of life and likewise for adult life, is less than either that of Reeth or Alston. The pulmonary mortality of adult women in Redruth is below that of the women of Alston and Reeth. The general state of the public health of Redruth is inferior to that of Alston. The mortality in early life especially, both from all causes and from pulmonary affections in the former, is much higher than the mortality sustained by the young population of the latter. Notwithstanding this, the influence of occupation seems well marked, for the death-rate of adult men is very nearly twice as high as the death-rate of women.'

In a subsequent account of Cornish miners, published in the *Third Report of the Medical Officer of the Privy Council*, 1860 (pp. 126, *et seq.*), Dr. Greenhow again took occasion to reassert the fact that the greatly higher mortality of males from respiratory diseases than of females, can only be attributed to the occupation of the former. Thus, he points out, that 'pulmonary affections produced an average annual mortality in Redruth at the rate of 6·70 per 1000 males, and 4·50 per 1000 females,' and that this mortality of females was almost the same as that obtained in six selected healthy

districts of Surrey and Sussex. This remarkable difference between males and females could not be referred to surrounding circumstances more favourable to the latter than the former, but was unquestionably owing to the occupation followed by the men.

Referring to the great depth of mines, he cites, in illustration, the Botallock tin mine, near St. Just, 180 fathoms deep, and the United Consols mine, at Gwennap, near Redruth, 280 fathoms deep. In the last-named mine, the temperature is as high as 125°, and the men can only work by short spells, and require to be constantly supplied with cold water for drinking.

The Cornish miners are naturally a fine, tall, well-grown race of men, very superior in appearance to the lead miners of the North of England; but they are usually sallow and pale, and very subject to dyspepsia, as well as to diseases of the respiratory organs.

Nearly all who work continuously for several years, suffer, sooner or later, from some form of pulmonary disease. The period at which they break down is influenced by the character of the mines, the nature of their employment (for this differs materially according to the branch followed), by their personal habits and their constitution, and by the proximity of their homes to their place of work; for it is observed that those do better who are compelled to take exercise in the open air by journeying to and fro to their work.

The greater the heat of mines, the greater is the proclivity to intercurrent catarrhal and inflammatory attacks from rapid changes of temperature. Hence it is that copper mines being hotter, the men suffer more. Such intercurrent illnesses accelerate the progress of the special lung lesions induced by occupation; but should they be escaped, miners will go on working without disabling illness for many years. 'For the most part, they become more or less asthmatical about the age of forty, and but comparatively few are met with between the ages of forty and fifty years, whose health has not been unequivocally impaired by their occupation,' still they often survive for many years after discontinuing work.

Although the special disease of miners is called consumption,

it is really not so, but rather a 'chronic bronchitis sometimes accompanied by emphysema, and more frequently producing anasarca, than the similar affection among lead miners.' Expectoration is commonly scanty, even when cough and hoarseness and dyspnœa have lasted a considerable time. At a later stage the sputum augments, and though usually black from the soot and dust inhaled, it will sometimes be rusty or red owing to the soil or dust of the mine containing oxide of iron.

Dr. Albert Bowhay, of Gunnislake, Tavistock, has kindly contributed the following notes on the diseases of tin and copper miners. These maladies, he writes, 'are those of the respiratory organs, and are due to the depth at which the miners work—often as much as 300 fathoms—the labour of climbing the ladders, and the heat and impurity of the air. The diseases in the order of frequency are, bronchitis, emphysema, phthisis, and asthma. Bronchitis can be easily accounted for, from the sudden change which they undergo from the hot and moist atmosphere of the shaft, to the coolness, and often coldness, of the surface atmosphere. Emphysema is frequently secondary to the bronchitis, but often primary as a result of the lung tissue giving way under the great strain which it undergoes during the act of climbing the ladders. The heart is, in these cases, hypertrophied. Phthisis is very common above the age of forty. The men are first subject to repeated attacks of bronchitis; after a time the lung substance breaks down, and a cavity is formed. Or more common still is *fibroid phthisis*, affecting the base of the lung. Asthma in miners is nearly always secondary to emphysema.

'Hardly any dust is generated, for our mines are so wet, requiring enormous pumping engines to keep the water down; consequently the *débris* is mud, not dust. The specific gravity of the ore is such that there would be no dust as in coal mines.'

Dr. Bowhay seems here to lose sight of the fact that much of the work falling to the miners, is cutting through and blasting the rock in which the metallic veins occur, operations inseparable from creating dust.

Owing to the prejudices of these workmen, an opportunity to examine the intrinsic alterations in lung tissue is denied

to the medical men who attend them in sickness. And I believe that could Dr. Bowhay get an opportunity so to do, he would not fail to perceive that dust had much to do with the setting up of bronchitis and the fibroid phthisis he speaks of, as well as the lesion comprehended under the name of phthisis. The differential characters of tubercular and of industrial consumption, need be worked out in this class of labourers.

On the subject of the mortality of metalliferous miners compared with non-miners, Mr. Robert Blee contributed a paper to the Royal Cornwall Polytechnic Society in 1871, showing, from the death registers, that the mortality of miners was 28 per cent., and of non-miners, only 18 per cent. of the deaths registered; and, that between the ages of forty and sixty, the proportion respectively was 36 and 20. With regard to chest diseases, the mortality from them amounted, in the case of miners, to 49 per cent., and in that of non-miners, to only 27 per cent.

The production of arsenious acid is very largely carried on in English metalliferous mines in connection with the getting of copper and tin, and an account of it occurs in the section upon arsenic.

Mining for other metals—silver, gold, and mercury—does not enter within the scope of this treatise, as it is pursued only to an insignificant extent in this country, and, except in the instance of quicksilver, has no very special characteristics of sanitary importance. And all that is of importance relative to mercury, comes under consideration in future chapters upon poisonous dusts and vapours.

Division ii.—*Other mineral matters*, mined or quarried, are limestone and chalk, alabaster or gypsum, barytes, flint, graphite, china-clay, fluor spar, clay, and slate. What morbid effects arise from the first stage of their quarrying, and throughout the simple operations resorted to in adapting them for use, are the consequences of dust inhalation; and these will vary in degree, according to the special physical and chemical properties of the dusts. As compared with coal-mining, the numbers engaged in obtaining the substances in question are inconsiderable, and data for evolving statistical conclusions are of scant proportions.

§ 1. *Chalk and Limestone.*—Labourers employed in quarrying *chalk* and limestone are, on the whole, a healthy class of men, as they escape, to a great extent, the inhalation of dust owing to their labour being carried on in open workings.

In *limestone* quarries, powder or other explosives are freely used for blasting, and, as a matter of course, a certain amount of danger to life and limb attends the work.

Men engaged about limekilns are exposed both to the dust of the natural stone and to that of the lime; but, as before noticed, there are grounds for believing that the carbonic acid of respiration is capable of acting upon such dust, and ridding the lungs of it.

Additional remarks on lime dust may be found in the description of the manufacture of chloride of lime in the chapter on non-metallic poisonous substances.

Lime burners have other risks than those of dust, present in exposure to heat and to the noxious gases given off by the burning limestone. From their knowledge of these evils the workmen usually protect themselves, but ever and anon some ignorant tramp, enticed by the warmth, lies down within the reach of the gases to rise up no more.

§ 2. *Flint* finds its use in glassmaking and in pottery. It is collected either as shingle from the sea-beach, or obtained from chalk pits. The flint of the mountain limestone is called 'chert,' and its almost exclusive use is for making the floors and 'runners' of flint-mills, where flints, previously calcined, are ground to a very fine powder.

This ground flint is largely employed in the china manufacture, and a cause of a vast deal of suffering, as will be hereafter pointed out when that industry is under consideration.

Flint-millers are few in number, but they suffer sadly with asthma and interstitial pneumonia.

§ 3. *Graphite* in its getting entails dust like coal mining, but very few are engaged in it. It has no special evils inherent in its composition, and its particles are not sharp and pointed.

Merkel (*op. cit.* p. 174) refers to a process for making slate pencils from graphite and clay, in the grinding of which

much dust is evolved, which eventually produces caseous pneumonia and degeneration of the lung tissue in the form of a hardened mass. This diseased material yielded to Dr. Kämmerer on analysis 1·2480 per cent. of graphite, and 2·5450 per cent. of mineral matter, made up of oxide of iron, clay, lime, and silica.

In the making of lead pencils, graphite dust is also given off, but we have yet to learn if those employed are direct sufferers from it. Graphite is, likewise, used for making the moulds for casting, in combination with charcoal and sand.

§ 4. *Alabaster, Gypsum, or Plaster of Paris* is of very wide use in the arts. It is obtained in a rocky, crystalline, diaphanous form as alabaster, usually in underground pits, but of no great depth. The labourers who quarry it do not, it would seem, suffer in any remarkable degree from their work. It is largely employed by plasterers, but its most important purpose is the making of moulds for casting ornamental objects and figures.

Quite recently I have had the opportunity of inspecting the most important alabaster mine in England. It has actual underground workings running far into a hill-side, and the alabaster occurs both in large irregular masses and also in a stratified form,—the strata here attaining a thickness of many feet, without intermixture of foreign material. My inquiries went to show that the miners did not suffer in cutting the alabaster itself, but did so to some extent from the dust produced in quarrying the surrounding rock and excavating the galleries. Moreover, to remove the ordinary rock, blasting with gunpowder was largely resorted to, with the result of fouling the air with the gases of its explosion. Except for these circumstances, the air was very pure, and no artificial ventilation was needed. The smaller blocks—unfit for the sculptor—were carried away to the neighbouring town, and there ground up between rollers to make plaster of Paris. This process was attended by the evolution of clouds of dust, but on questioning the men employed I found several who had worked in the mill from fifteen to twenty years who exhibited no chest symptoms, and were mostly healthy look-

ing and well nourished. None appeared ailing and anæmic, and all declared the dust had no ill effect on their breathing or appetite, and that it did not penetrate beyond their mouth and throat.

Such phenomena imply some peculiarity in the dust, robbing it of the usual irritating qualities of mineral particles. An explanation is difficult. But there are two or three considerations to take into account. In the first place, alabaster is not a truly sedimentary rock, like sandstone, the Yorkshire stone, or millstone grit. It owes its origin to a very gradual precipitation from a body of water containing salt and sulphate of lime. As the density of the water, nearly or quite stagnant, augmented by evaporation, the lime salt was the first thrown down as a simple chemical precipitate, and after that was accomplished the salt was left to accumulate above it, usually as rock salt. A precipitate of this sort will differ widely from a sandy or gravelly deposit from a muddy lake or river, growing solid under pressure, and abounding in siliceous matter.

This being the origin of alabaster, it is perceived that its structure is homogeneous, of very fine particles in the state of powder, and miscible readily with water.

The microscope confirmed these conclusions, showing an easy reduction of the material into powder, its ready miscibility with water, and its existence in crystals in the form of rhomboidal tables, with angles of no marked acuteness. It thus exhibited in a high degree the characters of a salt crystallised from some saline solution.

§ 5. *China Clay* is obtained from Cornwall, and consists of decomposed granite rock. To prepare it for the use of potters, it is submitted to repeated washings and siftings, and exposed to the action of the air for long periods. Its dust is pernicious, as will be best exemplified when the pottery manufacture comes to be spoken of. Happily for Cornish clay miners, their work is of outdoor character, and not like that of potters in close, hot shops, and besides the clay is moistened with water. They have, moreover, the advantages of residing in open country, instead of being cooped up in densely-populated manufacturing towns.

The knowledge of what may be their common diseases and their mortality is much to be desired, and must come from the local medical practitioners.

China clay, again, meets us as a cause of disease where it might be least expected, viz., in the weaving of cotton. We are assured that the quantity consumed in the cotton manufacture exceeds that supplied for the manufacture of pottery. In the former it must be regarded as a material of adulteration, whilst in the latter it is an essential ingredient. Its use in cotton is to give fictitious weight and consistence. The evils attendant upon this practice will be most conveniently considered when the manufacture of cotton comes under examination.

§ 6. *Slate Quarrying* employs a very large number of men, and is a laborious, rough, and dangerous occupation. This last incident—danger attends the operation of blasting and the mode of working where the quarry is an open one, and in terraces. It is only second to coal mining in the proportion of accidents happening. In the great Welsh quarries at Bethesda and Llanberis, the slate is excavated from the mountain sides; but at Festiniog it is raised from underground workings.

Happily, Festiniog possesses a medical man awake to the duty and advantages of examining an occupation in its health bearings, and we are able to extract some definite information concerning 'Slate quarrying as a dust-inhaling occupation,' from an address so headed, delivered by Dr. Robert Roberts, before the North Wales Medical Association.

The first fact noted is, that the Festiniog quarrymen are less healthy and vigorous than those of Carnarvonshire who work in the open quarries. The next is:—that the slate rock of Festiniog is softer than that of the latter-named district, and does not admit of the same mode of working.

Machinery is used for sawing and dressing the blocks of slate; and as this is done in closed shops, the workmen employed cannot escape breathing the copious dust given off. Before attempting to estimate the effects of the quarryman's labour, Dr. Roberts rightly investigated the local meteorological and geological conditions, and pointed out that the town is

seated in a deep valley with high mountains half encompassing it; that there is an average rainfall of 96 inches, and that the underground working spaces are wet and cold. Again, many of the miners work at very considerable elevations, exposed to thick mists and to cold. Taking these circumstances into consideration, he rightly infers that slate workers are subjected to conditions highly calculated to produce respiratory diseases.

The dust examined microscopically, appears made up of irregular, but sharply angular particles, often serrated. 'Yet' (writes Dr. Roberts) 'it is wonderful how little the quarrymen complain of any irritation or direct inconvenience from inhaling the dust. They soon become accustomed to their condition in life, and the only two discomforts which they generally seem to suffer are lassitude and thirst,' and these due rather to fatigue than any other cause.

Now it turns out that the pitmen who, besides dust and darkness, suffer often from imperfect ventilation of the workings, together with smoke from explosives and underground furnaces, are comparatively healthier and stronger than the millmen and slate dressers who work in the machine rooms on the surface. However, on this point another circumstance has to be allowed for, viz.:—that the latter enter on their work as apprentices when from twelve to fourteen years of age, whereas the pitmen do not commence their occupation till of mature age, in the prime of their physical energies, and, moreover, are constantly recruited from the ranks of agricultural labourers. These exceptional incidents augment the difficulty of determining the range of action of the dust itself as a morbid factor.

Nevertheless the death register of the district shows 'that amongst quarrymen, over the age of fourteen years, there have been 102 deaths from phthisis, and out of this total fifty-nine were slate quarriers, and only twenty-nine slate miners, and fourteen slate labourers; and even if we couple the slate miners and slate labourers together, as alike in working underground, and take the percentage out of the presumed number of 3500 men working in all the slate quarries, and that only 1000 of that number are slate quarriers,—a fair average, six per cent. of slate quarriers

have died of phthisis as against one and three-quarter per cent. of the slate miners and slate labourers combined.'

Even in the matter of sickness, after accidents have been eliminated from the returns, quarriers present a somewhat higher ratio. Anæmia, in moderate degree, is pretty general among them, and, for the most part, they are of slender development. Tea drinking is in great excess, being indulged in both between meals and at meals. Lastly, as piece-work is the rule and wages regulated thereby, the Festiniog men are induced to work hard.

Hirt quotes (*op. cit.* p. 137) statistics of the ages attained and the number of years the work had been followed without injury in a group of seven workmen; and concludes therefrom that slate quarrying, cutting, and cleaving, in the open air, is quite compatible with advanced years and good health. Not so, however, where slate is worked and smoothed in close huts, amidst clouds of dust. In such cases he asserts that it is productive of chronic pneumonia, or, as we should prefer to regard it, pulmonary fibrosis.

Hirt's statistical basis is too small to found conclusions upon, but so far as it goes it confirms Dr. Roberts' statement of the greater evils of dressing slate in enclosed buildings.

§ 7. *Granite, Marble, and Stone Quarrying—Stone Masons and Stone Polishers.*—All employed on these mineral substances suffer in various degrees with respiratory disorders, and, on the whole, more so than coal miners. The quality of the stone, in regard to its petrological characters, determines its severity of action; but observations have hitherto not been sufficiently numerous to establish the fixed relations between the character of the stone and the mischief caused by its dust. Speaking generally, sedimentary rocks composed of siliceous and readily detached particles do more harm on inhalation than primary rocks in which a fusion of their constituents has taken place. Other modifying characters are exhibited in the chemical composition, and in the miscibility of the mineral dust with fluid.

The product of the inhalation of the dust of stones of various sorts and of slate is the so-called chalicosis. Like anthracosis, it is a final result of a fibrosis, with its antecedents

as shown in long-standing bronchial irritation, in asthmatic breathing and in the whole series of symptoms betraying an 'industrial' consumption.

It was admirably illustrated by cases recorded by Dr. Greenhow in the *Transactions of the Pathological Society of London* (vol. xvii.), and by specimens still extant in the Museum of the Middlesex Hospital (Nos. 1276-78, and 1285-86).

In chalicosis greyish white concretions of mineral matter are at times expectorated; and similar formations occur in the lung substance, which appear as prominences when section is made; but such do not attain the dimensions of the like deposits seen in lungs charged with dust of iron oxides.

Granite.—From special inquiries I have made it would appear that the numerous hands employed around Aberdeen in the cutting, dressing, and polishing of granite are seldom victims of pulmonary lesions attributable to their occupation. This may be esteemed an unexpected fact, considering the density of granite and its lithological elements.

Professor Hamilton, of Aberdeen University (in a private letter), seeks an explanation from the igneous character of the rock, which opposes itself to the throwing off of dust, because its particles, unlike those of stratified rocks, do not exist in granite ready formed, but require to be made by the chisel of the workman. 'The dust in granite working would in all likelihood be coarser than in chiselling stratified rock, and would be caught in the superior respiratory passages without gaining entrance to the air-vesicles, where alone it seems to make its way into the pulmonary lymphatics.'

But whatever be its explanation, the fact remains, confirmed by several medical men of large experience in Aberdeen, that, though they suffer somewhat from chronic bronchitis, the severe lesions indicative of fibrosis and industrial 'phthisis' are almost unknown among the masons and polishers in the Aberdeen quarries.

From the report of the Chief Inspector of Factories (1880, p. 81), it seems that a like immunity is enjoyed by the labourers in the Purbeck and Portland quarries. Here the material is a limestone, of close, compact grain, and not a mass of imper-

fectly coherent particles of sand; in short, a marble,—a substance recognised by those who work it as but slightly detrimental to the respiratory organs. A parallel instance has already been pointed out with reference to alabaster.

Unhappily this comparative harmlessness of stone dust cannot be asserted of the majority of rocks quarried. The terrible fatality attending work on Edinburgh stone, especially that got from the Craigleith quarry, excited the attention of the late Professor Alison, and has been since noted by many other physicians. To students in that city 'stone-masons' lungs' is a well understood phenomenon. According to Dr. Greenhow's investigations, the quarrymen of Yorkshire, and those working oolite in Gloucester, Bath, and elsewhere suffer little less. Dr. R. W. Philip, of Edinburgh, who has great experience among masons at the Chest Dispensary, writes to me that a large number of cases of stone-masons' phthisis seek relief at that institution. The average age at which they come under observation has been about thirty-five. As a rule, the cases run a very chronic course, passing from recurrent to persistent attacks of bronchitis; the early stages are little marked, the most observable sign on auscultation being feebleness of breathing. When Professor Alison wrote in 1824, he stated that he had 'reason to believe there is hardly an instance of a mason regularly employed in hewing stones in Edinburgh, being free from phthisical symptoms to the age of fifty.'

In 1860 the late Dr. Peacock published in *The Medico-Chirurgical Review* some cases of lung disease he met with among patients who had been engaged as millstone workers, on the stone imported from abroad and known as 'French Burr.' They worked with a steel chisel and hammer, and in so doing leaned forward, as masons all do more or less, over the stone operated upon. He describes the symptoms suffered to be severe dyspnœa and cough, and slight hæmoptysis. The after-death appearances differed in different cases, but he speaks of blackened lung tissue, of masses of tubercles, so numerous as to produce solidification of tissue, and of pus-bearing cavities, and pleurisy with enlarged hard, black bronchial glands. Remembering the hypothesis of tubercle

in fashion at the date, his opinion as to the tubercular nature of the structures may be disregarded; and more especially as he tells us that Dr. Bristow examined the dense portions of lung microscopically and found them to be made up of fibrous tissue, and that, upon their combustion, siliceous particles could be detected in the ash. But Dr. Peacock noted a further incident common among these stone-cutters, viz.:—the presence of black papules on the back of the hands, which proved to be encysted angular particles of stone and iron. Similar discoloured spots are to be often seen among labourers employed in cutting various hard stones, in chiselling iron, and in coal getting, where particles are driven off with great force and penetrate the skin, and in the end become cicatrised over.

Dr. Peacock's conclusions as to the havoc caused by millstone cutting were alarming. Of the men so occupied in London, he calculated that 40 per cent. died of tuberculosis, and that among 41 labourers, of whom 23 were not above 20 years old when they commenced the work, the average age reached was only 24·1 years.

It is therefore a matter of congratulation that this trade of millstone making is wellnigh extinct; the new system of milling having dispensed with the use of stones by the adoption of steel-rollers.

Pointing to the same terrible loss of life of stone workers is Dr. Greenhow's remark (*Report*, 1861, p. 162) that, although quarrymen and masons only constituted 4·7 per cent. of the adult male population of Bradford, they contributed 6·3 per cent. of the deaths from pulmonary diseases.

In Dr. Ogle's instructive Table O (*op. cit.*, p. 58), showing 'the comparative mortality of males in certain dust-inhaling occupations from phthisis and diseases of the respiratory organs,' quarrymen exhibit the highest figure, excepting cutlers, file-makers, earthenware-makers, and Cornish miners. Comparing their statistics with those for coal miners, we find phthisis represented by 308, diseases of the respiratory organs 274, as contrasted with 126 and 202 respectively. The divergence in the matter of phthisis is remarkable—viz., 308 to 126.

As the particular quarrymen included are not specified, these numerical conclusions can only be accepted as applicable to the occupation generally.

The department of the masons' trade followed, and the incidental circumstances of the operations performed are attended by varied results. Thus, in some divisions of labour, the material is worked with more or less moisture, and, as in granite working, polishing machinery also is brought into use. On the other hand, in smoothing or dressing stone by chisels, a cloud of dust is driven off by every blow of the hammer; whilst the head and face of the artisan are more or less bent over the tools. Again, the work done has in some measure the advantages of an outdoor character. For stone-masons' shops are little else than covered sheds, open along one side; they consequently admit of the dispersion of dust by currents of air as fast as it is generated.

Division III.—Non-Metallic Mineral Dust produced in Manufacturing Occupations.

Sub-Section II.—*Manufacture of China and Earthenware.*—This manufacture stands foremost among those wherein the employment is distinctly chargeable with the production of disease; and the principal materials to which its unenviable character is due are the clays and the flint used in it. However, these mineral substances are not the only agents that render the fictile trade one so highly injurious to health; for lead also is largely used for glazing and colour-making, and is a frequent cause of plumbism among the artisans.

Again, it is a manufacture having many departments; between several of which no common characters can be said to exist. This holds good of the two principal departments, viz.:—(1) the making of the articles from the potters' clay; and (2) their ornamentation by painting and gilding. They are often spoken of as the 'clay' and the 'finishing' departments. It is with the former that we are in the first instance concerned, because in it alone the production of dust—the subject of the present section—is pre-eminently the cause of disease. Nevertheless, in dealing with the fictile trade, it will be impossible to avoid notices of other departments, in which the dust of clay and flint is but subordinate to other factors of sickness.

The clays used are derived from Cornwall and Dorsetshire; the local clays serving little other purpose than the material for making the boxes, called saggars, in which the ware is placed for the purpose of being 'fired' in the ovens. In some places, the local red clays form the basis for terra cotta ware, and in 'the potteries,' in encaustic tile-works, they also help to make the rough body of the tiles or quarries.

The best Cornish clay and Cornish stone yield a very fine white powder. Their origin is from decomposed granite rock, and the clay sometimes, chiefly abroad, goes by the name of Kaolin. The Dorsetshire clay contains more alumina than the Cornish stone; the latter being primarily a siliceous mineral. The damage to the lungs on inhalation is chiefly attributable to the minute particles of silex, which are angular, sharp-pointed, and quite unaffected by the blood and secretions they come in contact with.

Flint, in a finely-powdered state, is sparingly used in the making of the plastic clay or 'body,' of which pottery is constituted, but it is freely employed in the manufacture of china as a packing material within the 'saggars,' preparatory to firing.

The flints are prepared by calcining and grinding. They are imported from chalk districts, and from the shore of the northern coast of France in the form of small boulders.

Another material, almost exclusively resorted to in this country for making 'Parian' ware, is felspar. This is calcined and reduced by grinding to a fine dust. Plaster of Paris is consumed on a very large scale in the potteries, in the construction of moulds and models. Lastly, the bones of cattle enter largely into the composition of china, after being reduced to fine powder by calcining and grinding.

It is unnecessary here to signalise the many mineral substances used as colours. Those of them which possess poisonous properties will have to be noticed in the subsequent chapter on poisonous dusts. A bare enumeration may be, however, attempted. They are gold, silver, platinum, copper, tin, lead, mercury, cobalt, manganese and salts of iron, and chromium.

Happily, arsenic is volatilised by heat, otherwise its magnificently-coloured salts would doubtless be extensively employed; and, colours again of organic origin, as can be at once well understood, are useless. And though metallic mercury be used, it is not for the colours it can give by combination, but simply to make an amalgam with gold, from which it is eventually volatilised in the kiln fires.

Leaving, therefore, out of sight for the present, dusts of poisonous properties, we find potters subjected to the inhalation of dust from siliceous and common clay, from flint and plaster of Paris, from calcined bones, and sometimes from felspar. There is no need to say that they also get an abundant share of coal-dust and coal-smoke—the firing of pottery calling for a profuse use of coal—far too much of which is thrown off from the ovens in the shape of dense black smoke, intermingled with the gases of combustion.

As already implied, there are many divisions of labour even in the clay department. The typical potter, whose prototype is coeval with the earliest attempts of man at art, is the thrower, who builds up upon his wheel a multitude of forms of greater or less artistic beauty, classed as hollow ware. But much of such ware is made by men called 'pressers,' who form the article to be produced upon a mould made of plaster of Paris, having the required shape and size. Another class of pressers are occupied in making flat articles, such as plates and dishes and saucers; these are known as 'flat pressers.' The work of the hollow-ware presser, and, to some extent, that also of the thrower, is becoming replaced by a process of 'casting in moulds,' whereby the semifluid clay or 'slip' derives its shape and size. The same process is followed in the allied art of Parian manufacture.

The vessels, as they pass from the hands of throwers and pressers, have not the necessary smoothness of surface. To obtain this, hollow ware and cups are turned upon lathes; whilst flat ware, like plates and saucers, is smoothed by being rubbed, whilst in rapid rotation upon a small table, or 'jigger,' with tow or flannel—a modern process called 'towing.'

After this stage, it is ready for a first firing, which converts it to the 'bisquet,' or 'biscuit' state, when it can pass to the hands of transferers and printers, who imprint on

the surface the pattern desired, previously produced on thin paper from copper plates by an oily ink. After printing, another firing is needed to fix the impression; and either before or after the printing, the articles are 'dipped' in a glaze of borax and lead, which gives, when the ware is yet again submitted to heat, the enamel-like surface of our crockery, and thereby renders it impervious to moisture. Any amount of gilding, painting, and like artistic processes, may now be expended on the article.

The men who immerse the ware in the glaze are, from the operation, called dippers, and those who arrange it in the saggars for firing, are entitled 'placers.' The women who impress printed patterns on the surface, are named 'transferers,' and have under them more or fewer girls engaged in roughly cutting out the engraved patterns, and removing superabundant surrounding paper.

The men who fire the ware are distinguished as oven-men or kiln-men, and these have assistants who supply the ovens with coals, and otherwise render help. The incidents of an oven-man's life are—exposure, for longer or shorter periods, to a high temperature, to rapid transitions of heat and cold, to strong draughts, to mixed, sulphur and other fumes, and to considerable dust when emptying the saggars, as well as that from coal and waste matters, derived from broken saggars and ware. Their eyes are subjected to a very strong glare in watching the heat of the oven through small apertures from time to time; and the whole body streams with perspiration when the oven is drawn—a proceeding that takes place ofttimes whilst the ware is still in a highly-heated state.

Oven-men often combine their special work with that of 'placing.' This operation, in the case of 'biscuit,' is harmless, except from the dust; but when it is performed with ware just received from the dippers, the placers (in this case called 'glost-placers') suffer with lead poison in nearly equal proportion with the latter artisans.

To render the list of divisions of pottery labour complete, mention must be made of the men occupied in mixing and otherwise preparing the fictile clay, of the 'saggar-makers,' of the modellers and moulders, of warehouse-men and women,

of figure-makers as a special artistic class, of 'china scourers,' of handle-makers and handlers, and of 'lookers-to-ware.'

It will be apparent that a pottery resembles a colony of artisans whose employments differ as widely from each other as do many recognised distinct trades. This remark is here made with especial reference to the one principal department wherein the prime element of pottery,—clay, is the material worked. Its truth would appear on a still larger scale if the various divisions of the finishing department entered into the reckoning; and to give a satisfactory representation of what the pottery manufacture is in its entirety, this department will presently be taken into consideration.

It has been already remarked that the siliceous constitution of potters' clay is accountable for the mischief it causes to the lungs; and, as a general rule, the injury caused is greater in proportion to the amount of dust given off in the particular process carried on; with this qualification, that the effects produced are somewhat varied by the proportion in which silex is present. The fictile compound forming the 'body' of china articles is more prejudicial than an earthenware 'body'; and is rendered still more so by the employment of fine flint and sand for 'placing,' and by the necessity subsequently of cleansing the ware from the adherent dust.

The same fact is illustrated in the branch of the pottery business concerned in making what is called 'granite,' a superior and strong kind of earthenware mostly exported to the United States. The body of this ware is richer in Cornish stone than common earthenware, and proportionately more mischievous to those working with it.

To return to the fact that one branch of the trade suffers more than another according to the quantity of dust evolved in its exercise. This is noticeable in the greater frequency of lung lesions among turners and pressers than among throwers. But the strongest example of injury to health from the dust of the clay is found in the case of the 'china-scourers,'—always women, belonging usually to the rougher, more ignorant, and reckless of their sex. These women have to brush and beat off the dust from the chinaware after its removal from the saggars, a proceeding accompanied by the

production of clouds of dust. Where practicable, the scouring-rooms have of late years been provided with fans; and, in many instances, the operation is done within almost enclosed boxes, from which the dust is extracted by the suction power of the fans. Like plans have been successfully applied in the 'towing' shops, which were nearly as bad as scouring-rooms.

The introduction of ventilating-fans in the working-places of pottery establishments has been an immense boon, and, unquestionably, their good effects will, in the course of another generation, make themselves perceptible in the vital statistics of the trade. Unfortunately, though greatly needed, they have not been universally adopted; the explanation of which fact is to be found in the absence in many factories of steam power to give motion to the fans. However, this impediment will progressively disappear as the ill-arranged and insanitary buildings of former years give place to new ones specially built with sanitary precautions and furnished with mechanical appliances as now resorted to in the business. In fact, the last quarter of a century has brought about almost a revolution in the potters' trade. Prior to that period the production of pottery was wholly manual, aided by some simple mechanical arrangements moved by human power. Now, every year witnesses the development of machinery, displacing human toil, facilitating production enormously, and removing causes of bad health.

The ventilation of factories has all along been a stumbling-block with architects and factory owners. The men and women demand a warm atmosphere, and this is often supplied beyond requirement by the heat from drying-stoves and presses and hot-water pipes. From this over-supply follows high sensibility of the artisans to draughts, and the consequent aversion to all openings from without, as exhibited by the persistent closing, on their part, in some fashion or other, every ventilating aperture the ingenuity of architects has introduced into their shops. The use of properly-constructed fans obviates all these difficulties and disadvantages, alike removing dust and securing ventilation without draughts.

That the inhalation of dust is the cause of much disease and misery, and of premature decay and death, is a fact every potter is ready to admit; and rational people would

expect that every potter also would gladly use whatever means against this source of illness could be devised; but the marvel is that these artisans view the matter with astonishing indifference; they accept their fate of chronic disease and shortened days. Hence they are less attentive than they should be to personal cleanliness, to the wearing of suitable clothing, to the freedom of their workshops from clay-besprinkled floors and accumulated dust on all sides, and to ventilation. Plans introduced from time to time to amend their conditions of labour have oft been frustrated by negligence or by wilfulness. The very obvious plan of avoiding dust inhalation by wearing respirators gets little or no favour, chiefly because to do so exposes them to the ridicule of their fellows, and at times proves embarrassing to the breathing. Moreover, what is viewed among them as the exercise of British independence becomes a bar to the introduction of many sanitary regulations, such as exist in the best-managed factories of France and Germany. There is, however, with respect to respirators, this valid objection, that by their ordinary construction of wire gauze, the moisture of the breath seizes on the minute particles of clay, and forms a sticky mixture, which after a short time chokes up the apertures in the gauze and renders respiration difficult. These metallic respirators are likewise too rigid, and embarrassing to the muscular movements of the mouth and nose. A filmy veil of cotton-wool, or a fold or two of crape, would more thoroughly sift and exclude the dust, and would be less stifling, easily renewable, and almost costless.

The pulmonary mischief from the dust of potters' clay is slow but sure in its occurrence. The siliceous character of the clay lends it more potency for harm than almost any other form of dust. Still, on the whole, it would seem rather less injurious than metallic dust, as seen in Sheffield. It is much more irritant than coal dust, and stands on a par with the worst kinds of stone dust. Its mode of action and its effects upon lung tissue have been already described in the special chapter On the Pathology of Dust Inhalation. The differential characters of the disease it sets up from those of tubercular phthisis have also been noticed in a general fashion; but they deserve being recalled.

When uncomplicated by tubercles the potters' disease advances imperceptibly, and without constitutional disturbances. One of its first symptoms is a clearing cough on first rising, but soon to be met with on any change of temperature, and accompanied by shortness of breath. Hæmoptysis does not usher in the malady, and more frequently than not never makes its appearance. The appetite and the general bodily functions remain long intact; there is no febrile action, no accelerated pulse, no hectic, and no rapid emaciation. Anæmia is no necessary adjunct. The sputa remain for long white and frothy, with specks or streaks of black matter, which is inhaled dust. Later on this mucous expectoration gets purulent, heavy, and forms pellets, but is not green. The cough is more paroxysmal and violent than that of phthisis, and the urgency of the dyspnœa greater, and out of proportion to the ascertained extent of consolidated lung. The signs of condensation are not so specially limited to the infra-clavicular spaces as in tubercular lesion, and hence the sinking below the clavicles is not marked. Areas of dulness on percussion are often found distributed at different parts, particularly in the scapular region, and near the base of the lungs. Between these an emphysematous condition is discoverable; a phenomenon more common along the anterior margin of the lungs. There is not an equal shrinking and contraction of the thoracic cavity at large. Ulceration of the vocal cords and aphonia are wanting, and so likewise are the 'cracked-pot sound' and cavernous breathing.

As might be foreseen from the increased strain on the pulmonary circulation, the heart gets frequently involved, the right side becomes dilated, and the valves inefficient; hence anasarca in prolonged cases is no infrequent occurrence before the scene closes. I would add that the general aspect and physiognomy differ from those of tubercular phthisis. The features are rather those of asthmatical subjects; the countenance is not pinched or sunken; the lustrous eye, the often pink and transparent skin of phthisis, the clubbed finger-ends, and the incurved nails are wanting.

But in looking for these distinctive signs, we must never forget how frequently tubercular deposit modifies the picture of fibrosis I have endeavoured to present.

Before dismissing the consideration of the clay department of the pottery business, a few words are needed respecting some subordinate processes.

The first business is the preparation of the clay to form the fictile mass or body, out of which the various articles are to be formed. The mixing of clays of different sorts with flint is a dusty operation, but few are employed in it. These ingredients have to be thoroughly mixed with water and brought to a proper consistence—the resultant material being called 'slip,' and its preparers 'slip-makers.' Formerly this was done in tanks by means of a long and broad oarlike piece of wood, which was worked by hand, so as to stir and thoroughly intermix the materials, heat being at the same time applied by a furnace beneath the tank. This was a laborious and sloppy business, and is now almost everywhere replaced by 'presses' of elaborate construction, and demanding no great exertion from those who work them. This new method is also much cleaner than the old one.

Another branch having distinct health features is that of firing the ware, either in ovens or kilns. In this operation the men are exposed to great heat, to considerable dust proceeding from the coal used, and to fumes and dust from the burning material. Also, when an oven is drawn, the man or men who enter are subjected to an excessively high temperature, producing profuse sweating and exhaustion and to sulphurous fumes from the expiring fires. Again, in emptying the saggars, a large amount of dust is thrown off. Moreover, oven-men suffer greatly from the draughts of cold air which forcibly invade the heated interior of the places in which they work; and this evil of their occupation is increased by frequent careless exposure of themselves to the outer air, when they are heated and sweating.

The men who arrange the ware in the boxes or saggars, prior to firing, are called 'placers,' and, as already noted, are of two classes—one dealing with articles fashioned by throwers and pressers before being glazed; and the other, with those which have passed through the hands of the dippers, and are coated with the lead-enamel or glaze. The former have only to contend with mineral dust; but the latter with lead dust also, and, in consequence, frequently become victims of

lead-poisoning. They constitute the division known as 'glost-placers,' whilst their fellow-workmen are called 'biscuit-' ('bisquet') 'placers.'

These several branches of work are in many instances not kept distinct. Thus the oven-man is often also a 'placer,' and a biscuit-placer will at times take the place of a glost-placer.

By keeping in view the circumstances of the callings of these several workmen, we are prepared to find that those employed about ovens are especially liable to rheumatic affections,—generally of a chronic and local form in the shape of lumbago and sciatica. They are, likewise, in a higher ratio than other labourers about potteries, subject to acute inflammations of the chest.

The *vital statistics* of the pottery business remain for examination. They tell a sad tale of disease and early death. I shall first refer to the so often quoted observations of Dr. Ogle, and afterwards add those I have myself collected. I may preface my remarks by observing that the loose definitions of employment to be found in mortality registers detract considerably from the value of the statistics based upon them. Perhaps, in no instance, is this more patent than in the returns made of the deaths of potters. The word potter is of a very elastic character, and may be extended to mean any workmen employed in a pottery. But it has been shown how very widely the operations in pottery manufacture differ in hygienic conditions. Even were it a fact that registration returns excluded nearly all artisans occupied in the finishing department, there still would remain a large section of workers, engaged in employments very diverse in health conditions, to whom the calculated statistics would not correctly apply.

However this may be, I will now give a summary of Dr. Ogle's statistical inquiries. He cites Dr. Farr's statement that 'this industry is one of the unhealthiest trades in the country,' and adds,—what is most unsatisfactory,—that the mortality rates on which Dr. Farr founded his opinion in the preceding decenniad, have, in the subsequent ten years

increased at each of the two age periods (25-45, and 45-65),' and now show a comparative mortality figure of no less than 1742, which is only exceeded in the table by the figures for costermongers, Cornish miners, and inn and hotel servants. This excessive mortality is in greatest part due to phthisis and diseases of the respiratory organs, the deaths from these two causes being represented by 1118, while the number for all males is only 402; so that the mortality under these two headings is almost three times as great in this industry as among average males. There is only one occupation, viz., mining in Cornwall, in which the mortality from these two causes is higher; and scarcely any other in which a near approach is made. The mortality from diseases of the circulatory system is also extremely high' (their comparative mortality figure being 160, as contrasted with the normal 120); whilst that 'ascribed to alcoholism and to liver disease seems to imply a certain but not very great amount of intemperance.'

Dr. Ogle proceeds to refer to lead-poisoning. This he assumes generally to be an incident peculiar to dippers; but, as the preceding history of pottery shows, this supposition is not correct. Neither again is the inference he gathers from his returns that, 'taking the industry in the aggregate, there is no evidence, either under the headings, Diseases of the Nervous System, or Diseases of the Urinary System, of any considerable amount of chronic lead-poisoning, such as we find among painters and filemakers.'

For here, again, the imperfections of mortality returns mar special deductions. A good many deaths happen from lead, which get variously assigned to colic, stoppage of bowels, constipation, and other abdominal disorders; and a certain proportion of deaths among publicans and petty tradesmen result from plumbism; the keeping of a beer-shop being a favourite accessory occupation among dippers and placers, as well as other classes of pottery workers.

Further, the smallness of the percentage of deaths from renal diseases does not really assist the argument. My long and extensive experience among the victims of lead poisoning in 'the potteries,' has convinced me that the general assumption of the connection between plumbism and kidney

disease does not hold good, at least not in the case of potters exposed to lead. Among hundreds of cases of wrist-drop and other varieties of paralysis, as well of colic and constipation from lead, the existence of albuminuria will be looked for in vain; and when found, its ratio among workers in lead is not greater than it is among the general population.

Again, the statement that painters and file-cutters suffer in a greater degree from their occupations from lead-poisoning than do potters must be received with misgiving. The statistical comparison made between the trades in question follows on different lines. In the instance of potters, the proportion of sufferers from plumbism is calculated on the entire number of those artisans, whereas but less than a twelfth of them are exposed to lead poison; on the contrary, with regard to painters and file-cutters, the whole of them are in contact with the poison, and consequently their comparative mortality from it is necessarily very high. The inference, therefore, that these latter workmen are far more frequently victims of plumbism than are potters, rests on a false basis. The workmen with whom the comparison should be made are the dippers and glost-placers viewed alone.

As physician to the large North Staffordshire Infirmary, situated at Stoke-upon-Trent, in the midst of the working population of the potteries, I have from time to time gone largely into statistics to show the prevalent diseases and the mortality of the district, and have recorded the results arrived at in various papers, contributed to medical journals and to societies. I will now make use of some of those published memoirs.

The mean age at death of male potters, aged twenty and upwards, was forty-six and a half years, whilst that of non-potters stood at fifty-four. The most prevalent causes of death among the former were diseases of the chest, pulmonary consumption, and diseases of the heart and nervous system. On the other hand, whilst potters had a mortality from chest diseases of 12·29 per cent., other workpeople had only one of 7·86. Likewise, the former died from consumption in the proportion of 12·90 per cent., the latter in that of 9·27. In the matter of heart diseases, these stood at 4·03 in the one, and 2·21 in the other section of the community.

The deaths of male potters from diseases of the respiratory organs, in relation to their *entire mortality* from all causes, were 60 in place of 27 per cent. as calculated for the entire male population. The maximum of deaths from these maladies occurs in the decennium of life from fifty to sixty, and declines progressively in each preceding decennium, as the twentieth year is approached. In the twenty years between forty and sixty, 43·52 per cent. of the entire mortality happened. With regard to phthisis, the maximum mortality was reached between thirty and forty. The inference is, that pulmonary consumption cuts off potters predisposed to it in the highest ratio prior to the fortieth year; whilst those not so predisposed fall victims to the non-tubercular chest lesion, the special consequence of the employment at a later life-period.

The very extensive out-patient practice of the infirmary furnishes ample statistics of the diseases for which treatment is sought. Of 800 treated, all of whom were occupied in some department of the pottery manufacture, 463 were males, and 337 females. The percentage of the diseases found in the two sexes stood thus:—

	Males.	Females.
Bronchitis, ...	36·57	7·14
Phthisis, ...	20·90	16·96
Rheumatic affections, . .	7·79	4·46
Stomach disorders, . .	8·44	19·64
Plumbism, ...	8·00	5·06
Cerebro spinal diseases, .	4·32	2·97
Cardiac disease, ...	2·81	2·08
Epilepsy, ...	1·73	4·46

This table is contrasted with the following similar one for *non-potters*:—

	Males.	Females.
Bronchitis, ...	48·00	16·00
Phthisis, ...	13·00	11·00
Rheumatic affections, . .	21·00	1·00
Stomach disorders, . .	19·00	31·00
Plumbism, ...	0·00	0·00
Cerebro spinal diseases, .	5·00	2·00
Cardiac disease, ...	6·00	3·00
Epilepsy, ...	5·00	7·00

The reading of these figures distinctly shows that there must be something special in the work of male potters to account for the occurrence of bronchitis among them to the extent of double what happens among workmen of like ages engaged in pursuits of all sorts other than potting. On the other hand, the variation in the proportion of phthisis between the two classes is far less marked, although this malady indicates a higher frequency among potters of both sexes. Gastric troubles abound far more among non-potters than with potters—a fact accounted for by the circumstance that the average age, especially of female out-patients, is greater in the case of the former; and that amongst them is a larger proportion of hard-working, ill-fed and broken-down housewives, wanting the means possessed by the working pottery hands for securing proper food and lodging. The last-named again have the advantage of better protection against inclemencies of weather—a fact that further displays itself by the lesser frequency of rheumatism among them. On the other side, a higher ratio of phthisis indicates the operation of causes more favourable to the onset of that malady—such, for instance, as mineral dust, confinement in hot shops, and sedentary work—than prevail in the general mass of poor women.

Whence arises the astonishing high ratio of bronchitis among male potters is demonstrated by the following table of the registered illness of pressers,—a class of workmen exposed more than any other to dust inhalation:—

Males-Pressers, 263.

Bronchitis was present in . .	55·5	per cent.
Phthisis, ...	in 17·8	do.
Stomach disorders, . . .	in 10·6	do.
Cardiac lesions, ...	in 2·28	do.
Epilepsy, ...	in 1·52	do.

Respecting the nature of sickness among clay workers, not pressers, and either turners or throwers, the percentage found is, for bronchitis, 1·7, and for phthisis, 23·9. Compared with pressers, the number of these artisans is very small, and accordingly the number available for data are too

small to insist upon as representing a general average. The same defect presents itself on contrasting female workers in clay with those of the same sex occupied in the finishing department of the manufacture; but, taking the percentages for what they are worth, that of lathe-traders, handlers, and scourers suffering phthisis was 21·33; whereas that of paintresses, transferers, burnishers, gilders, and warehouse women, was only 15·21. In the matter of bronchitis the former showed 12, the latter 7·8 per cent. Here again dust shows itself to have been an aggravating cause both of phthisis and bronchitis. Taking china-scourers apart, phthisis was the malady in 40 per cent., and bronchitis in 25 per cent.

Paintresses had a death-rate per cent. of 13 from phthisis, and of only 3 from bronchitis; whilst gastric derangements mounted up to 19, and uterine to 21.

On turning to the list of out-patients from the dipping-house, viz., dippers and dippers' helpers (the latter chiefly women), and, on analysing their maladies, no doubt can be entertained concerning the activity of the poison used in the glaze. Of 60 dippers noted, 47 suffered colic or paralysis, or both, or lead arthralgia; and no other diseases figure for more than the unit, excepting heart lesion, of which there were two cases. Bronchitis and phthisis reckoned only one case each; whereas among glost-placers the former occurred in 13·6, and the latter in 18·1 per cent.

At present, in the absence of sufficient numbers I shall not extend this statistical inquiry respecting the various distinct trades or branches of this complicated manufacture further, except to note that nearly one-half of the cases of sickness met with among firemen and kilnmen—not exposed to lead poisoning—were of the rheumatic form, chiefly local rheumatism in the form of sciatica and lumbago.

As before stated in the chapter on coal-miners, the statistics of sickness among the members who avail themselves of the benefits of the local 'Provident Association,' show a less proportion of recipients among potters than with colliers. On the other hand, they demonstrate a decidedly higher death-rate among potters.

The finishing department.—A brief account of this may be introduced in this place in order to complete the sketch of the pottery manufacture, as understood in its wide significance; although dust indeed is not the active cause of disease operative in this department. Its two principal divisions are, painting and gilding; both essentially sedentary occupations. Painting on china or on earthenware in all particulars, save in the composition of the colours employed, resembles painting on any other suitable material. Its incidental characteristic is that of sedentary employment. The colours must withstand fire, and are consequently of metallic or mineral origin. Many of them have poisonous qualities, for the most part derived from lead; a circumstance causative of lead-poisoning in certain branches of painting. Most painting is done in what are called enamel colours, either on the glazed surface or else beneath it. They are laid on with camel-hair pencils, and mixed with turpentine, paraffin, or petroleum, and, in superior ware, with essential oils, as media. Even where the colours contain lead, this enamel painting, when done with ordinary care and attention to cleanliness, is rarely attended by any injury. However, in ornamenting very common ware, the colour is only mixed with water or weak gum-water, and being daubed on rather than painted, it begrimes the workers' hands, and, at times, causes plumbism. Similarly in making 'majolica' ware, the colours are heavily laden with lead and mixed with water, and from being roughly and thickly laid on the surface of the vessels ornamented, are liable to soil the hands and clothing, whilst at the same time, from rapid drying, they form a fine dust, readily detached. Hence it is that majolica painters, usually women, are among all engaged in the 'finishing' department, the most frequent sufferers with plumbism. There is yet another mode of colouring the surface of ornamental ware called 'ground-laying,' wherein the colour prepared with lead as its flux in the form of a very fine powder, is dusted on the surface. As might be expected, the contact of the poisonous colour and its inhalation render 'ground layers' frequent victims of lead-poisoning.

Of late, a process of lithographing in colours on ware has been invented. There is nothing prejudicial to health in the

use of lithographic presses, but an evident risk is run from the mode of application of some of the colours in a state of powder dusted on the outlined surface, when those colours, as is most frequently the case, contain lead.

The other leading division of the finishing department is that of gilding. Formerly gold was reduced to a fine powder, united with mercury, and then mixed with some oil as a medium. The resultant black-looking semi-fluid was then laid on by pencils. When fired in the kiln the mercury was dissipated, and the gold remained in a dull form and required to be brought up to its metallic appearance by rubbing with an agate, or other hard, smooth stone—an operation known as 'burnishing,' and almost wholly in the hands of women. German ingenuity has, within recent years, contrived to make a preparation of gold in a liquid state, of the consistence and colour of treacle, which is applied by pencils, but, after firing, requires no burnishing, and consequently has the merit of greater cheapness as compared with the old process, which it has displaced, except in the case of goods of higher quality.

Gilding, like painting, is a sedentary occupation, involving a stooping attitude at the work-bench. In the finishing rooms there is a strong odour of turpentine and other oils used, which to the uninitiated is a cause of headache and anorexia. This evil is made worse by the almost constant heat of the workrooms, by gas emanations, and by a widely-extended neglect of, and indifference to, ventilation; and because no dust of consequence is generated, ventilating fans are not deemed necessary.

It has seemed to me that, among old gilders, their employment is indicated by a black line on the edge of the gums with surrounding abnormal redness.

It is necessary to mention one other incident met with among burnishers, that is, the practice of wetting the gilded surface with saliva, to facilitate the use of the agates. This expenditure of saliva, although not at any moment considerable, is carried on continuously by them while at work; and the conviction cannot be got rid of, that this diversion of secretion that should enter the stomach, and the constant

wasteful flux from the salivary glands, must prejudicially abstract secretion, and have a weakening effect, particularly on digestion. To arrest this practice gum-water has been introduced, but the women usually prefer their saliva as more ready at hand.

The finishing department embraces a limited branch of labour, consisting in making sunk patterns on the surface of china, by 'biting' them in by the agency of hydrofluoric acid; the pattern thus produced being afterwards decorated by gilding. In this operation the vapours of the acid are given off in sufficient quantity to constitute an annoyance to the artisan, and, after a while, to produce a sense of great debility with acid dyspepsia and gastric pain. As extremely few individuals follow this employment, opportunities are of rare occurrence to study its effects. I have seen only one or two cases where working with this acid was clearly the cause of ill-health; but there is no question it is one in pretty constant operation among such work-people, though unless attention be specially called by them to it, very often its effects are overlooked, and their symptoms attributed to other circumstances.

Mother-of-pearl manufacture has its chief seat in England, at Birmingham, and although employing some two thousand hands, must be looked upon as one of comparatively small extent. Likewise, it is unfortunately a decreasing trade, owing to foreign competition and the efforts of the workmen to keep up the rate of wages. For from the fact of its being a limited trade, it proved a convenient one for the exercise of trade tyranny on the part of the workers themselves; who, though understanding perfectly that its exercise destroyed health and shortened life, yet made it a rule of their society, that no improved processes of manufacture should be introduced into their workshops! The purpose in view was primarily to prevent competition in labour and the reduction of wages.

The cutting, turning, drilling, and polishing of mother-of-pearl are attended by a large amount of heavy dust, which, from its composition, operates on the respiratory organs in the same fashion and degree as mineral dust. What are the lesions produced by its inhalation we have the great advantage of learning from Dr. Headlam Greenhow, who described them

in the *Transactions of the London Pathological Society* (vol. xxi. p. 66). This excellent pathologist stated that he had satisfied himself of the identity of the lung affections of these workmen with those 'of miners, potters, flax-dressers, and other operatives exposed to inhale air charged with dust.' The symptomatology, moreover, is alike between them, and especially the long existence of shortness of breath before cough and other indications of broken-down health and lung lesion evidence themselves.

The specimen of lung exhibited in illustration was of a general black colour, with thickened pleura and numerous dense, hard, well-defined nodules, from the size of a hazel-nut to that of a millet seed. 'These nodules cut with a smooth, firm section, and were of a blackish-grey colour, being less deeply pigmented than the spongy lung tissue immediately surrounding them. Under the microscope they showed fibrous tissue with interspersed granular pigment, sometimes contained in cells, but more frequently lying loose' (*op. cit.* p. 67).

Layet gives a very good account of these artisans, and rightly insists on the increased injury they suffer by leaning forward in working the lathe, and thereby bringing the nose and mouth into proximity with the shell and the dust arising from it. He also remarks on the sickening odour of the dust, dependent on the remnants of decomposing animal matter existing in it. Besides the respiratory troubles—obstinate cough, asthma, and free expectoration of muco-pus, and occasionally of blood in small quantity, he notes the occurrence of blepharitis and conjunctivitis, and the formation of fissures in the skin of the hands. A concluding observation is, that although they suffer so seriously with lung affections, their mortality from tubercular phthisis does not exceed the ratio found among other artisans.

Connected with this trade is a remarkable affection of the bones. Dr. B. W. Richardson, in his excellent little manual on *Health and Occupation*, thus refers to it:—'The internal layer of the pearl is an organic material which is soluble in water, and which has received the name of *conchyoline*, and this substance, separated in the lungs from the calcareous matter which is mixed with it in the pearl, is

dissolved and carried by the current of the arterial blood from the lungs into the arteries, and thence into the minute vessels of the circulation. In the minutest of these vessels, in the portions of the ends of bones, near joints, called the epiphyses, the foreign substance causes irritation, and swelling, and pain, and other symptoms resembling acute rheumatism' (p. 71).

This view of the pathology of this curious form of periostitis appears a very rational one, nevertheless pathologists do not seem satisfied with any hypothesis yet advanced. In the *British Medical Journal* for April 19, 1890 (p. 910) we meet with the following notice of the lesion:—Dr. W. Levy 'has noted five cases within four years in Berlin, where about 500 mother-of-pearl workers are employed. These work-people are nearly all adults. The patients were from twenty-one to thirty-one years of age, and all five had worked over five years at the trade. In the first patient the inferior maxilla was attacked; in the second the left clavicle and afterwards the lower jaw; in the third the right metacarpal bones; and in the fourth the lower jaw and afterwards the lower part of the right humerus. The fifth patient had been fourteen years engaged in the business. During his first year the right scapula was attacked, and two relapses followed in the course of the two succeeding years. Four years later periostitis occurred in the right superior maxilla and the right clavicle. Afterwards the left side of the lower jaw, the left metacarpals, the right femur, and the left tarsal bones were involved.'

The reader of this account will be struck with the predilection on the part of the jaw-bones to this peculiar periostitis, and will recall that a like phenomenon attends on phosphorus poisoning. Further, the anatomical structure of the bones involved does not lend support to Dr. Richardson's hypothesis of the limitation of the periostitis to osseous structures remarkable by the smallness of their blood-vessels.

It is to be hoped that some one of the well-known pathologists of Birmingham, where mother-of-pearl working is specially pursued, will apply himself to elucidate the course and mode of production of this very peculiar trade disease.

The ill-consequences of mother-of-pearl work are aggravated by the accidental circumstance, that it is an occupation open to any mechanic of ordinary skill without the expenditure of capital upon plant. Few tools are required, and it can be carried on by females and children in their cottage homes, where sanitary arrangements to lessen its evils are unknown or unused, and the hours of labour extended at pleasure. Another reason for a high mortality is to be found in prevailing intemperance and dissipation, coupled with a low rate of earnings, and indifferent, if not decidedly bad food and lodging.

Sand and Glass-Paper Making is a very limited occupation, but is rendered important hygienically by its destructive effects upon health and life. These effects were cogently insisted upon by Dr. Richardson in the course of lectures already referred to (*Lecture* II. p. 130). The sand or glass, or a mixture of the two, having been previously ground in a mill, is sifted through a fine sieve as equally as possible over the paper, prepared by adhesive matter to receive it. The doing of this by hand is necessarily a most dust-producing process, and in illustration of the harm done thereby, Dr. Richardson records the case of a boy, under his own observation, who was attacked with cough the first day he commenced work, rapidly developed signs of acute pulmonary disease, and died within the month.

The expectoration, Dr. Richardson adds, 'gave evidence under the microscope, of the presence of the foreign irritative substance, and after the death of the sufferer, the diseased lungs in their minute vesicular structure (for the mischief was nearly equally spread over each lung) gave the same fatal evidence of the presence of the foreign particles.

Every sheet of paper was made in the same fashion, but it is satisfactory to add that the mode of proceeding has latterly been changed, and machinery invented to do the sifting. The trade, however, is one that cannot be wholly freed from the danger of mineral dust inhalation.

Slag Grinding.—This is a comparatively novel proceeding, characteristic of this present age, in which ingenuity is

especially directed to the conversion of waste products, heretofore so regarded, to useful purposes. This fact is exemplified in the utilisation of the slag remaining after the formation of 'basic steel' as a fertiliser for agricultural purposes. The slag is rich in phosphate of lime, and to bring it into a condition suitable for the object intended, it has to be reduced to a fine powder by crushing and grinding. This operation is necessarily a very dusty one, and cannot fail to be injurious to those exposed to its inhalation. The process being quite modern and very few labourers engaged in it, no attention has yet been given to it in respect of its influence upon health. A chief seat for the production of this so-called slag-phosphate meal is Middlesboro', and it is very desirable that some medical men of that place should take up the question.

Cement-making has grown into a manufacture of considerable magnitude, and is one of those occupations driven outside of towns in consequence of the annoyance,—chiefly from the smoke given off, attending its processes, to the surrounding population. Those working on the premises are less conscious of the smoke nuisance than people at a distance; but the former are exposed to dust in an intense form, though this, as experience proves, is not so damaging to health as might be expected. The raw materials of cement are clay, with flint and lime, and tenacious argillaceous mud from river beds, or the deposits from extinct lakes. And, chemically, cement may be described as a double silicate of lime and alumina, coloured by oxide of iron.

After the materials have been well mixed and ground together in a sort of mortar-mill, to the consistence of liquid mud, the next business is to drive off the water by heat, and then to subject the dried substance in kilns to a still higher temperature. From the latter the cement is withdrawn, and then ground between rollers to the requisite fineness.

The operations are simple though coarse. The primary mixing and grinding being done with a free supply of water exhibits no insanitary conditions. The subsequent evaporating process whereby the semi-liquid mud is brought into a dry state, was formerly conducted in shallow pans, into which

the material ran through pipes, and was thoroughly stirred by workmen who waded in the hot mud, exposed to heat and steam, and who were, in consequence, sufferers with rheumatism. This old plan has been replaced by the construction of tunnel-like chambers, having each a furnace at one end, the heat from which travels the whole length, and gradually produces the requisite solidity of the 'slip' spread over the floor. The presence of men is not required until the time arrives for emptying the chamber; when this happens the labourers enter and dig out the cement, sending it up to the surface through an opening provided at one end. In this proceeding the labourers suffer from great heat and also from the dust. But the most continuously dusty work is in the 'mill,' the air of which is clouded with cement.

Inquiry among the workmen elicited the fact that, after a while, they became short of breath and suffered cough, though not in a high degree; and that on rising in the morning, they had to clear their chests by expectorating viscid mucus containing cement dust.

Another evil was the irritation of the eyes and transitory conjunctivitis; and a still more noticeable one, the production of ulceration, chiefly of the septum of the nose, ending in its perforation and partial destruction. This incident, though primarily due to the irritation of the cement, is doubtless also, in some measure, attributable to efforts made to dislodge the mass of dust and mucus that obstructs the nares, by the finger nails; for handkerchiefs among these labourers are rarely patronised.

This manufacture will again come under notice in the chapter on noxious vapours, the evils of which have made much deeper impression on the public mind than those of its dust.

The Dust of Iron Compounds.—We give place here to the few particulars to be stated respecting salts or compounds of irons used in the arts, instead of describing them with metallic dusts, with which they are conjoined by Hirt and Merkel. For their pathological features are rather those of earthy than of metallic dusts properly so called, such, for instance, as the dust given off in grinding iron and steel.

The compounds used are the protoxide and peroxide of iron, and, to a very limited extent in colour-making, the phosphide. Zenker was the first to establish the inhalation of the red oxide, or red ochre, and to note its pathology. It is largely used in the arts both as a polishing and a colouring agent.

Merkel recounts meeting with sixteen cases of deposit of the dust of iron compounds in the lungs. In ten cases, the red oxide was the form used, in nine of them for colouring paper, and in the other, for glass polishing. In two, the sub-oxide was the material, and was used by iron polishers. In the remaining one, it was the phosphide, and resorted to as a colouring material.

The general symptoms (writes Merkel, *op. cit.* p. 176) resemble those of anthracosis, and the sputum has a blackish colour; but the nature of the colouring matter is at once revealed by treating it with dilute hydrochloric acid, and adding the ferrocyanide of potassium, when the distinctive Prussian-blue colour is at once displayed.

The lesion set up commonly proves fatal in the course of two years, from its first manifestation in a cough. When the expectoration grows purulent, particles of the dust may be observed in it. And the phenomena present are those of chronic fibrosis and pleuritic adhesions and the formation of cavities, with fever, night sweats, diarrhœa, and increasing debility; with, now and then, intercurrent acute pneumonia, and signs of local emphysema or of bronchiectasis. With these phenomena may be conjoined those of impeded general or portal circulation; in the shape of hydropericardium, hydrothorax, ascites, enlarged liver, albuminuria, and anasarca.

Dust atoms, of the colour belonging to the oxide employed, occur on the bronchial mucous membrane; and a dark reddish fluid exudes from the lung tissue on cutting into it; whilst small nodules or concretions project from the surface, and emphysema, to some extent, is apparent along the margin of the lungs.

Where the disease is of longer standing, the small concretions collect together to form considerable masses, without actual loss of individuality. At various parts, but mostly about the apices, in the hard contracted tissue, are found larger or smaller, smooth-walled, single, or compound cavities,

within which may usually be detected particles of the dust. Likewise caseous deposits, varying in size, are at times seen within the alveolar spaces where the dust has penetrated. In no other organs, excepting the bronchial glands and lungs, has the dust been found.

As with anthracosis from coal dust, so here in the case of iron dust, a slow interstitial inflammatory action is set up, leading to cirrhosis of more or fewer lobules. Such lobular fibrosis is, however, not an essential phenomenon, for there may be a general diffusion of dust throughout the pulmonary tissue with arrest of its functions. The formation of cavities may, it would seem, originate from a necrosis of tissue, or by extension from ulceration of the bronchial walls.

Other Non-Poisonous Dusts acting Mechanically on the Respiratory Apparatus.—Of such several might be mentioned, but since as pathological factors they differ in no essential manner from various other dusts already described, they call for no special consideration. Should they possess a decided colour, the pulmonary tissue will partake of that colour in some degree. Thus it is reddened by the dust of oxide of iron, and made blue by ultramarine (Greenhow's specimens Nos. 1284-1286, and 1287 Middlesex Museum). The existence of the morbid specimen last named, affords ground for noting in this place that, although ultramarine is a natural product in the shape of the mineral called lapis lazuli, yet it is, for the most part, for trade purposes, artificially made by the blending of kaolin with sulphur, and a salt of potash, with the addition of a minute proportion of iron. Having this composition, it is at once evident that we have to do with a mineral dust which must operate on pulmonary tissue much after the same fashion as china clay.

Dr. Greenhow's specimen shows induration of lungs by fibrous deposit, and, as Merkel states, blackish specks and stripes. Bronchiectatic cavities have also been noted, and the mineral substance occurs in small molecular specks made up of lamellated crystals.

Workers in *soapstone*, used for making gas-burners, who inhale the dust, exhibit similar symptoms and lung lesions. The same may be stated respecting workmen who largely use

polishing powders; as, for example, emery and powdered pumice or rotten-stone; but the harmful effects of these substances are greatly lessened by their intermixture with oil and other ingredients, which tend to consolidate the dust and prevent its dispersion.

We learn from Dr. Richardson that the sulphate of iron, or copper, is used in fur-dyeing, for dyeing skins black. 'After the skins have been treated with a solution of the salt, they are dried and beaten with a bat, and thoroughly brushed.' The dust proves irritant to the lungs, but seems to set up, on account of its solubility, no permanent lesion, though its corrosive action on bony substances is exemplified by the destruction of the teeth, which become brittle, and, for the most part, carious (*Lecture* II. p. 133).

Sub-order B.

METALLIC DUST ARISING IN MANUFACTURING OPERATIONS.

Dusts of inorganic and metallic origin.—Metallic dust is produced in a multitude of employments connected with the manufacture of 'hardware'—a comprehensive term, including well-nigh all articles made in metal. It would be both impracticable and unprofitable to examine the hardware trades individually in connection with the present subject, viz., the evolution of dust as a morbid factor. The making of nails, bolts, locks, and other small ware has already been dealt with, and the present division of our subject will be devoted chiefly to the hygienic conditions and the diseases of electro-plate making, of the cutlery and associated trades pursued chiefly in Sheffield, and of needle-making; and be followed by some observations on the manufacture of iron and of tin, so far as attended by the emission of dust.

The Manufacture of Electro-Plate.—This is largely carried on in Sheffield and Birmingham, and to a small extent elsewhere. At first sight it would not seem to have a place among dust-producing trades. Neither has it in regard to its essential process—the depositing of silver, or gold, or nickel upon other metals. However, in certain departments, particularly in the finishing ones, much dust is created. In

the preparatory cleaning of the metals to be plated in acid, and alkaline solutions, and also in immersing them in the baths where silver or gold is deposited on them by galvanism, some gaseous matters are thrown off, yet to no such extent as to tangibly affect health, provided space and ventilation are ample. But after the deposit is complete, the surface of the article has to be highly polished, and this end is attained by the friction of rapidly-revolving wheels, covered with leather, and dressed with a polishing-powder of some sort, such as emery, lime, whiting, or the red oxide of iron or rouge. After the wheels have done their work, the final lustre is obtained by manual friction with a small quantity of rouge.

Such operations are necessarily attended by the giving off of much dust, an occurrence unfortunately treated by the work-people with great indifference, and as one calling for no protective measures. A less looked-for source of dust is connected with the process called 'spinning,' whereby a hollow-ware article, like a teapot or dish-cover, is produced from a flat disc of soft metal, such as the Britannia metal. It would be vain to attempt to describe the operation, for this must be seen to be understood; but its essentials are strong, physical force, and friction with a steel tool acting upon a piece of metal in extremely rapid rotation. According to the workmen, a certain amount of metal is detached in a very fine form by the friction, which causes tracheal irritation and cough. What may be the pathological consequences of these processes is a problem that should be inquired into by medical men advantageously placed for so doing. Indeed, some sanitary inspection of these factories seems very desirable, as many collateral trades are carried on, at least in some of them, of which the ill-consequences are well understood. For instance, ivory and mother-of-pearl cutting and polishing, the hafting of knives, and even a little steel dry-grinding, are seen in these electro-plate establishments.

Sheffield trades.—Although electro-plating and the making of articles in Britannia and other artificial metallic substances is a considerable business in Sheffield, it occupies a very secondary position compared with the manufacture of what are specially called Sheffield goods, including cutlery of all

sorts, and large articles made in steel and iron, such as fenders, stoves, etc. It is the making of goods of this character that lends importance to the Sheffield trades hygienically. The dust thrown off in the many processes is a factor of disease surpassed by none; for, as before remarked, the particles of steel and iron are particularly injurious to lung-tissue by reason of their mineral constitution and of their sharp, acuminated and jagged outline.

The excessive prevalence of chest-diseases among Sheffield grinders, and the abnormally high rate of mortality therefrom, has been a long-admitted fact. Statistical inquiries on the subject were instituted in 1843 with great assiduity by Dr. Calvert Holland, who long practised in the town, and wrote an excellent account of the common diseases of the artisans, under the title, *Diseases of the Lungs from Mechanical Causes*, 1843. These inquiries were followed up by Dr. Greenhow, and, later on, by Dr. J. C. Hall, another physician of large experience in Sheffield. Dr. Greenhow's results were published in the oft-quoted official medical reports, at that period issued under the direction of Sir John Simon; and Dr Hall's were given in a series of essays published in the *British Medical Journal* in 1857. More recently Dr. Sinclair White produced some excellent memoranda in his admirable reports as Medical Officer of Health, and his able successor in office, Dr. Theodore Thomson, continued the good work. What is lacking, but should not be so, especially in a town boasting a medical college, is a thorough examination of the lesions originating in metallic dust inhalation, in all stages and under all circumstances. Pathology has advanced by long strides since Drs. Holland and Hall treated of the symptomatology and morbid appearances of grinders' consumption; and it is a duty incumbent on the best pathologists Sheffield can produce to give a complete clinical history and *post-mortem* record of the destructive malady which is rife on every hand among the artisans of the town.

There are many departments in the Sheffield trade differing widely from each other in their health relations. That which stands far ahead of all the other divisions of labour as provocative of disease, is dry grinding. The roughly-shaped forged piece of steel has to be reduced to its proper

dimensions and figure, and afterwards polished and sharpened. The first part of the work is done on a rapidly-revolving grindstone, the article to be ground being held by the hands against it with more or less pressure, the workman sitting astride in front upon a bench called a 'horsing,' and leaning forward, to a greater or less extent, over the stone, with the elbows resting on the knees.

The process of grinding may be wet, or dry, or a combination of the two, according to the character of the work to be done.

It appears that at the beginning of this century dry grinding was little carried on. The workshops, or, as they are denominated locally, 'the wheels,' were years ago for the most part situated in the country; being planted where there was a good stream of water to supply the motor power. Increasing trade, the introduction of steam-power, and various circumstances progressively lessened the number of the water-wheels, and concentrated the manufacture within the area of Sheffield town, with the result of imparting to it more and more of a factory character. The result was a general deterioration in sanitary conditions of the workers. Instead of the old moorland sheds, through which the healthy breezes from without could freely circulate, more solidly-built structures arose within the town, with enclosed workrooms, the greater warmth of which was appreciated by the decreasingly robust workmen. Contemporaneously dry grinding, chiefly of smaller articles, scissors, forks, penknives, and razors, extended itself; for it facilitated the rate of production beyond what could be attained by wet grinding. Happily, however, the latter has not been wholly superseded. Saws, scythes, and other large tools, and also table-knives are yet ground on wet stones; and water-power is still resorted to in various localities around Sheffield. Moreover, on my recent visit to the town, I was assured that wet was replacing dry grinding in respect of several articles.

We are all familiar with the work of itinerant scissor grinders, and can therefore get some conception of what dry grinding is, and of the dust attending it. What we see on this small scale we have to conceive to be multiplied manyfold in a Sheffield grinder's shop; or, as it is locally called, his 'hull,' where many and often large stones are in action.

The stones differ in diameter according to the size of the articles to be ground. Besides the grindstone, the working cabin-like space, technically the 'hull,' is furnished with a wheel, termed a 'glazer,' on which the implement is smoothed and also with a wooden tool for smoothing the sides of razors and penknives, and a polisher.

Each grinder carries on his work within his own hull, and of this limited apartment he is commonly only a tenant, paying rent for it to the owner of the factory or 'wheel,' to whom he is responsible for nothing else except the performance of the work he undertakes. Within the same general shop are more or fewer hulls, very imperfectly divided off from one another, and it is no uncommon occurrence that adjoining hulls are occupied by wet, and by dry grinders—a state of things very prejudicial to the former.

Another evil attending this peculiar system of tenancy is, as the Factory Inspectors have reason to regret, that each artisan enjoys just so much independence, and so entire control over the work he takes in hand, as to create the greatest obstacles to the introduction of improved methods and arrangements for work, or of sanitary provisions to render his labour less unhealthy.

The position of grinders at large stones, astride for hours together on their 'horsings,' cannot be otherwise than fatiguing, and the impression will cross the mind that this state of things must be unfavourable to the functions of the bladder and to the healthy condition of the lower bowels; but, excepting the statement of Dr. Holland, that grinders suffer above the average from gravel, no evidence is forthcoming that those viscera are unusually prone to disease; and as to the occurrence of gravel, it is with more probability assignable to intemperate habits and exposure to atmospheric changes and frequent wetting than to aught else.

But if innocuous with respect to the pelvic viscera, the prolonged bent position and the environments of the grinders favour the production of chronic rheumatic ailments affecting the muscles of the back and legs—especially in the case of wet grinding—and Dr. Holland refers to many men becoming incapacitated for work by reason of lumbago and sciatica.

Many small articles, such as penknives and scissors, are ground and finished on smaller stones, when the bent posture is not necessary; and the workman can stand at his employment.

After being shaped and ground to the required dimensions, the next business is to burnish or polish the articles. This is accomplished by wheels covered by leather, and also by a thick bundle of linen rags cut and bound together in the form of a wheel, and which by rapid rotation assumes the character of a solid mass, and, at the same time, one so soft as to serve better than any other contrivance for the purpose of surface polishing.

To assist in giving polish to the articles made various powders are employed—for example, emery, whiting, rouge, powdered pumice, etc. The use of these materials adds vastly to the dust of the trade and to its pernicious results; but no data are in existence to indicate what is its share in the causation of disease as compared with the dust of the grindstones. Still, no question exists that these polishing powders, differing as they do among themselves in physical qualities, differ likewise in the range of their effects upon the lungs.

Another plentiful source of dust arises from the 'hanging' and 'racing' of the grindstones. The former operation consists in boring a hole through the centre of the stone for the passage of the axle: the latter in levelling and smoothing the working face of the stone by pressing against it a bar of steel as it is slowly revolved. Moreover, the constant wear and tear of the stones necessitates a daily renovation of the working face, which is done by hacking or rough chiselling, and the inevitable production of dry dust.

Were it practicable, it would be well if wet-grinding replaced dry-grinding altogether; but it is not so, for many smaller articles—forks, for instance, require the harder and coarser friction of dry stones. Notwithstanding, wet grinding has its own drawbacks, in the shape of a moist atmosphere, of splashes of watery mud, of the wetting of the men's clothing, and of water-soddened floors.

We will now pass on to review the morbid consequences attending the several branches of the Sheffield hardware

business. Grinding, as already shown, is by far the most important pathological factor of the trade. The dust thrown off is a mixture of particles of metal, and of sand derived from the wearing of the grindstones.

The quality of the dust, or the relative proportion of steel and of stone particles in it, differs according to the hardness of the metal and the fineness of the grindstone; and, to some extent, on the degree of pressure used in grinding. The quantity thrown off depends on the article to be ground. The roughly-shaped razor has to be greatly reduced by grinding; Dr. Hall states that a single razor loses from eight to ten ounces by grinding—a statement which forcibly illustrates what an amount of dust must be generated. The dust from the grindstone appears like a dense shower of sparks, yet when the hand is thrust into it, it gets no harm by burning. However, in the dry-grinding of larger ware, as the eyes often suffer from the ejected particles, spectacles are worn as a protection. The minute particles are known among the men as 'mites.'

The entrance of the dust by the ori-nasal passages, in the first place, sets up tracheal and laryngeal irritation, and, as consequences, huskiness of voice, and a short cough, provoked by the feeling of something in the throat to be expelled. The cough is, in the first instance, dry, but sooner or later is accompanied by the discharge of a greyish mucus.

This collection of symptoms constitutes the first of the three stages of lung disorders recognised by Dr. Holland.

His second stage is marked by increased cough, with dyspnœa, aggravated on the slightest exertion. The countenance indicates suffering; the body is bent forward; the pulse slightly accelerated, but there is no fever. The expectoration has grown more opaque, and by its colour at times shows the existence of pus: usually, too, it is darker in colour than that of phthisis. Pains in the chest are now common, and made worse by exertion; but the appetite mostly remains good, and emaciation, if observed at all, proceeds slowly. The percussion note over the chest is, for the greater part, clear, and in places loud; whilst the breathing is noisy and bronchial. In this stage, hæmoptysis is not infrequent.

In the third stage, all the symptoms become aggravated

especially the difficulty of breathing; the expectoration is now thick and copious, and wasting of the frame and exhaustion advance to the fatal termination.

Just as with the potters' disease, so with the grinders' phthisis—commonly known as 'grinders' rot'—there is no necessary connection with tubercle, although the latter may, and often does, complicate it. So, again, the differential symptoms between the two are, in all essential particulars, the same as those already described in the case of the potters' asthma, with these exceptions, that hæmoptysis is more common and severe, and the formation of cavities by breaking down of lung tissue more frequent.

The surface of the lungs displays black specks, and the consolidated portions are hard and tough on section, and of varied shades of red, brown, grey, or black; whilst the pleura is thickened, and forms adherent bands (see Dr. Greenhow's specimen, No. 1283).

Dr. Calvert Holland writes:—'The expectoration is often very peculiar, both in the second and last stages of the disease. It is by no means uncommon for grinders, after a slight fit of coughing, to bring up black, hard masses, in appearance accretions of dust, varying from the size of a pea to that of a small marble,' with sensible relief to their breathing.

But besides the special chest lesion, grinders have their full share of acute pulmonary affections and of rheumatism; in a large measure, due to their own indiscretion by exposure of the body when heated, scanty clothing, reckless living, and frequently by insufficient food and neglected sloppy working places.

More frequently in former than of late years, owing to fluctuations in trade, the Sheffield grinders were subject to periods of great hardship and misery; but they now partake the general advantages accruing to other artisans in this country, from the very considerable advance in wages. Yet they too often make no good use of improved social conditions and better wages, and have the reputation of being an intemperate body of men.

Dr. Holland records it as his experience, that wet-grinders, as a body, are superior to dry-grinders in intelligence and respectability; and that it is an indisputable fact 'that the more destructive of any of the various departments of grind-

ing, the lower the morals and the remuneration of the workmen' (*op. cit.* p. 30). The moral tone of the dry-grinder is lower, and when adverse circumstances overtake him, he exhibits remarkable recklessness.

Formerly Sheffield grinders accepted their fate as an unavoidable incident of their calling. Their indifference to suffering and early death was further exemplified by their practice of introducing their children to their own work whilst still very young. The Factory Act has gone a long way towards remedying this state of things. It has prevented the employment of very young children, and has enforced—so far as the peculiar relations of the artisans to the factories and their owners admit—ventilation by means of fans—called locally 'fannies'; and by both measures, has effected a considerable diminution of disease and mortality, as the statistics, compiled by Dr. Sinclair White, demonstrate. To Dr. Holland belongs the merit of recognising the sort of ventilating apparatus required, and of urging its adoption; the skill of engineers has, since his day, given practicability to his suggestions. Still, however, there is great room for further sanitary improvements in the Sheffield factories, but their accomplishment will be, as before said, seriously impeded by the existing system of sub-letting working spaces and motor power, making thereby every sub-tenant of a factory a master, who may, by ignorance or wilfulness, frustrate all endeavours to render work and workplaces more healthy.

File-Making.—The department of the Sheffield trade concerned in making files ranks, in regard to health considerations, on an equality with grinding. The first process of forging and shaping files resembles smiths' work; not so the subsequent one of cutting the grooves or raised ridges or points which give those tools their utility. Viewed as a mechanical art, it is a very simple one, requiring only a hammer and chisel with the manual skill, generated by use, in cutting regularly and with equal force. However, to carry out this operation, the piece of iron, properly shaped, is placed on a leaden cushion called the 'bed,' whereby the jar or vibration from the elasticity of the iron at each stroke of the hammer is reduced to a minimum.

It is in the use of this lead 'bed' that the chief ills of file-cutting arise. The file is steadied on the bed by the inner side and little finger of the left hand, which, at the same time, holds the cutting chisel. There is thus constant contact with the metal with more or less friction; but this apparently slight handling of the lead is, at least, contributory to the production of plumbism. Yet, without doubt, this source of injury is abetted by the minute particles of the metal detached by the perpetual blows upon it. For an evident amount of dust collects about the 'bed' and on the workmen themselves, in which atoms of metallic lead may be found. It may, therefore, be fairly assumed that some particles find their way into the respiratory passages—an incident favoured by the bent position over the work. Others will gain admission into the stomach, particularly when food is eaten whilst at work, or when placed near the bench. And each mode of access is facilitated by the prevalent indifference of the file-cutters to cleanliness of person and clothing, whence it happens that the evils of the workshop are transferred to their homes. It is, besides, by no means uncommon for the men to moisten their fingers from time to time by licking them, for the purpose of preventing their gliding over the surface.

The clauses of the Factory Act endeavour to mitigate the evils of the occupation by forbidding the taking of meals whilst at work; but such a rule will be but little effectual where a few isolated workers are collected in an out-of-the-way small shop, who also are adults and masters of the situation, and make it their one object to gain good wages, equal to their temporary purposes, in as brief a time as possible. Legislative enactments are good in themselves, but they are overmatched by ignorance, prejudice, and selfishness.

Sheffield has many other industries connected with the working of steel and iron; but they do not exhibit such special health conditions as to need particularising. The hafting of knives, forks, and other articles; engraving on steel blades and tools, and file-stripping are operations to be met with in most of the factories. There are also works where spring-making or casting is a principal occupation, besides large establishments or foundries for making ranges and boilers, and the huge works of Messrs. Armstrong for

constructing artillery. The most common of the health conditions of these places of labour are noticed in the account given of iron foundries and forges.

Vital Statistics place the special occupations of Sheffield near the top of the list in the bills of mortality. Dr. Ogle has calculated the mortality figure and the mean annual death-rates of those employed for the two periods of life, viz., twenty-five to forty-five, and forty-five to sixty-five. But his conclusions are vitiated by reason of the imperfections of the returns on which they rest, and which are more considerable in a manufacture like that under notice, where there are many departments, each of which has its own health features. Indeed, Dr. Ogle has had this circumstance in mind when framing his table; for he has recognised three groups of Sheffield workmen, entered severally as (1) 'cutlers, scissors-makers,' (2) 'file-makers,' (3) 'cutlers, scissors, file, needle, saw, and tool-makers.' This grouping is, however, too heterogeneous for an accurate estimate of the health conditions of Sheffield artisans.

The term cutler has not, in Sheffield, the meaning popularly given it; that of a maker of scissors, forks, razors, and other small cutting utensils. Such a one is a dry grinder; whereas a cutler is one who makes heavier goods, edge-tools, saws, and scythes, all which are wet-ground. Leaving out of consideration the question how far the cutlers returned in the general mortality registers are such in reality, we may remark that to conjoin cutlers and scissor-makers together in a statistical calculation is an error. The same remark applies to the third group alluded to, even more forcibly; for in this are introduced needle-makers, whose business does not belong to Sheffield, and possesses health aspects of its own.

The second occupation named, viz., *file-making*, we take to mean file-cutting; since file-makers are, in a strict sense, not file-cutters. It is the latter artisans who have special sanitary aspects and call for separate statistical notice. Dr. Ogle's results, as presented, are beset by the doubt what artisans are intended; but he calculates the mean annual death-rate of 'file-makers,' between twenty-five and forty-

five, to be 15·29; and between forty-five and sixty-five, 45·14, and their comparative mortality figure as high as 1667. Turning to the comparative mortality table (p. 32 *op. cit.*) we are at once struck by the high ratio of nervous maladies, which stands at 262, as contrasted with 119 for all males in England and Wales, and, likewise of diseases of the urinary system, represented by 123 in place of the normal number of 41. In the mortality from nervous maladies, 'file-makers' exceed every other class. Again, diseases of the circulatory system are in excess, being as 180 to 120; but what appears remarkable is that the mortality from phthisis surpasses that calculated for cutlers and scissors-makers, whilst, too, that from respiratory affections falls little below what the latter workmen suffer. To cite figures, the file-makers' mortality from phthisis stands at 433, as contrasted with 371 for scissors-makers and cutlers, and with the normal, 220. So, again, the three corresponding figures representing mortality from respiratory maladies are, 350, 389, and 182.

Looking to the excessive mortality from phthisis and chest diseases, as just illustrated among those entered by Dr. Ogle as 'file-makers,' we are inclined to believe that some individuals so returned in the public registers were not file-cutters, but 'file-grinders;' a subdivision of the file-making occupation. As grinders, we should anticipate a high mortality among them from those diseases, though allowance must, in respect of this point, be made for the fact that file-grinding is wet grinding, and therefore less obnoxious to health. Another suggestion is, that the lead dust is contributory to this high mortality of file-workers from phthisis. This is conceivable, because the highly irritant qualities of metallic particles of all sorts are undoubted. But we cannot assign any weight to the poisonous properties of the lead, for we fail to trace any connection between lead poison and tubercular phthisis, and are rather inclined to attribute the circumstance to the unusually prevalent dissipation of file-makers. Besides, in all discussions of this sort, the conclusion is apt to be vitiated by the confusion prevailing in mortality returns between tubercular phthisis and the consumption due to fibrosis from dust.

Dr. Calvert Holland instituted most searching inquiries relative to each branch of labour as followed in Sheffield; noting social conditions, ages at which work was commenced, educational attainments, scale of wages, and relative mortality; but as nearly fifty years have elapsed since his work was published, we hesitate to make full use of his statistics, considering that within that period no small changes in sanitary and other conditions have taken place.

His results showed that each principal department of the Sheffield trade had its own special health conditions and rate of mortality. The one pre-eminent for its destructiveness to life was *fork-grinding.* It is a process of dry grinding. Of sixty-one deceased, thirty-five died before reaching their thirtieth year, and forty-seven under the age of thirty-six. None of them lived beyond their fiftieth year. Of 1000 deaths in England and Wales, 160 took place between twenty and thirty; in Sheffield 184, and among fork-grinders 475. So, again, between twenty and forty, 885 fork-grinders out of 1000 died, whereas in the kingdom at large the proportion was only 296.

Razor-grinding proved not so bad. It is not wholly a dry process. Of 1000 razor-grinders, 749 died under forty-one years old; whilst in the general population of Sheffield the number was 3·52. None lived to appear in the table above sixty-five. Scissor-grinding has much the same mortality. It is partly a dry, and partly a wet-stone, business. Of 102, eighty-six died under forty-five years old, and only five lived beyond fifty. Above sixty-five none were found alive; whereas in Sheffield at large, 244 attained that age and upwards, and in the Midland counties generally as many as 413.

Penknife grinders were in no better plight. The death register showed none to have lived beyond sixty. Of 1000, 402 died between twenty-one and thirty, 329 between thirty-one and forty, 209 between forty-one and fifty, and sixty between fifty-one and sixty.

Table-knife Grinders are the most numerous, and work with wet stones. No death above the age of sixty was recorded

among them. Of a total of fifty-two deaths, nineteen occurred between the thirtieth and fortieth years, and as many between forty and fifty. In Dr. Holland's time, children were put to work when only nine years of age.

Saw-grinding is for the greater part done in the country, and water used as the motor power. The men employed in it have much more outdoor life than the town workers, and are a finer, stronger race. Indeed, they must of necessity be vigorous men, as their work is laborious and requires great strength. They always use wet stones, and when at work occupy an erect position. 'Their occupation' (says Dr. Holland, *op. cit.* p. 96) 'is not detrimental to health, except from the severity of the labour.' But in this branch the workmen are liable to accidents from the bursting of the grindstones, which are of great diameter, and from accidental contact with their machines on account of the length of saws. Of forty-two deaths, five arose from bursting of the stones, and only nine of them were under the age of forty.

Scythe-grinding is a closely similar wet process, carried on usually in the country, and almost as healthy an employment as that of saw-grinding.

File-grinding occupies few men. It is a wet-stone employment, and little less healthy than saw-grinding.

It seemed a general rule that, where a trade was exercised both in the country and in the town, the artisans in the former were more healthy, more respectable, and better educated.

The foregoing returns, quoted from Dr. Holland, tally with the more recent ones of Dr. J. C. Hall. Fork-grinders he stated to stand first in rate of mortality. Excluding all under twenty-one years old, he calculated that of 160, the average age reached at death was only twenty-nine, and that the expectation of life, when work was begun at ten years old, did not exceed fourteen years. The average age at death he represented to be, for razor-grinders, thirty-one; for scissor-grinders, thirty-two; for saw-grinders (working with wet stones), thirty-eight; and for table knife-makers,

thirty-five. At the most healthy factory 'wheel' he knew of, the average of the artisans was forty-two. Dry grinders, often before attaining their twentieth year, exhibited signs of lung disease.

When introducing the numerical statements of Dr. Holland, it was remarked that ameliorations in the state of things when he wrote must be anticipated. Some improvements in machinery have been made, yet not to the extent we find in almost all other manufactures, for the prejudices of the men offer a fatal obstacle. More distinct benefits are to be traced to the adoption of fans to remove the dust from the workmen, and to a decided advance in the sanitary condition of the people by the provisions of the Factory Act, which restrict the hours of work, prevent the early employment of young children, and reduce those under fourteen to the position of half-timers, and thus promote education. In another direction, a lessened mortality is to be anticipated by the substitution of wet for dry grinding in an increasing number of articles.

Granting all these favourable influences to have been fully at work for some twenty years, we are scarcely prepared for the statistical conclusions arrived at by Dr. Sinclair White, when medical officer of health for Sheffield, from the mortality returns of 1885. He, indeed, remarks that the figures in his table must be accepted with caution, because, besides the fact that his data are drawn from only one year's experience, the number of deaths in each trade is small, and especially so when they are distributed according to diseases and age-periods; and, in the next place, because the estimated number of workmen in each of the trades noted is only approximative.

His numerical results are thus expressed: 'Adding together the three headings, viz., grinders, cutlers, and tool, fork, and scissors-makers, we have a total of 316 deaths among a class of workmen computed to number 17,074 persons. This is equal to a death-rate of 18·5 per 1000 per annum. The death-rate prevailing among all males in Sheffield over the age of fifteen during the year was 17·3 per 1000 per annum.'

On comparing his returns with those of Dr. Ogle, he

observes that, whereas this statistician reckoned deaths from phthisis to equal 28 per cent., and those from respiratory diseases 29 per cent., his calculations show only that 19 per cent. arose from the former, and only 22 from the latter maladies of the entire number of deaths.

Among file-cutters, the figures indicate an excessive proportion of deaths from phthisis, and from diseases of the nervous system attributable to plumbism. Few in this trade attain the age of sixty-five and upwards.

Dr. Theodore Thomson, the able successor of Dr. Sinclair White, introduced in his annual report for 1888, a 'Mortality Table in reference to Trades,' but he abstained from drawing specific conclusions therefrom, looking forward to the more favourable basis attainable when a series of years can be dealt with, and when the number of workers at the various trades and occupations has been satisfactorily demonstrated.

Needle-making.—Allied to the staple trades of Sheffield, is the business of needle and fish-hook making. Its principal seat is at Redditch and some neighbouring towns; and there is an old-established centre at Hathersage in Derbyshire. Dr. Holland examined the health aspects of the occupation in the last-named town, and was led to the conclusion that the grinding of needles exceeded in its fatality that of Sheffield goods. However this may have been at the date of his inquiries, there is nothing at the present day in the occupation to sustain this opinion. Needle- is of necessity dry-grinding, and differs in no material points from the same operation in making cutlery.

The needle-pointer sits at his work, but not astride his stone on a seat, as in most branches of the cutlery manufacture, because the articles he makes are very small, and only a small grindstone is required.

But this circumstance entails the necessity of leaning forward over the stone, just as happens in the making of penknife blades and other small ware; a position increasing the chances of inhalation of the dust. To grind the needles, the workman gathers from fifty to a hundred between his forefinger and thumb, arranging them skilfully with all their points in the same direction and in a ribbon-like line, and

thus secures each and all getting the same amount of grinding as he holds them against the stone. This proceeding is attended by the production of a large amount of steel-dust, mixed with dust arising from the wearing away of the stone, with the appearance of sparks. The amount of dust generated in a large factory is indicated by the size of the 'dust house,' the common receptacle for the dust from all the stones at work. It is likewise demonstrated by the diffusion of the dust on the roofs of all surrounding buildings, to which it imparts, when it first falls, a dark grey tint, which changes to red when rain falls.

As in the best working places of Sheffield, so in the needle-factories, extraction tubes connected to fans are attached to each grindstone, and the major part of the dust collected and drawn with force from the pointers. This admirable contrivance has converted a most health-destroying trade into a comparatively harmless one. It cannot remove all the dust given off in grinding, for some little falls around the workman and collects about his working bench. This latter I found to be composed chiefly of particles of silica, thrown off from the stone by centrifugal action in curvilinear lines outwards, mixed with particles of steel. At Messrs. Cook's factory at Hathersage, as I learned from the Factory Reports, a second extraction tube is placed behind the wheel and at a lower level than the one in front, to catch and carry away any dust that may escape the latter. Another precautionary device at times adopted, is to place above the grindstone a wet cloth, to prevent the rising of the dust, leaving only so much working surface of the stone exposed as is required by the grinder.

It is to be regretted that there are several small factories and a multitude of cottage workshops in Redditch, where needle-making goes on without, or with very few, appliances to deprive it of its destructive character. There are many poor cottages, the ground-floor room of which serves as workshop, living-room, and at times also, as a sleeping apartment for one or more members of the family, competing with well-built factories fitted with the best machinery; it follows that these poor operatives have to labour, regardless of ordinary working hours and of all sanitary conditions, for

the most miserable remuneration; and occupy towards those who buy of them, a position in all essential points resembling the victims of the London 'sweaters.' When, therefore, we are called upon to estimate the consequences of the special trade of Redditch upon its workpeople, it is essential to bear in mind the extraneous incidents that appertain to social position, lodging, and food.

Whilst needle-pointing is pre-eminently the most dangerous branch, there are others calculated to damage. And it may be mentioned, in passing, that, according to local reckoning, each needle has to go through some seventy stages or operations between the first act—the cutting of the steel wire of the requisite length, and the last one—the final polishing, done in bags subjected to rolling and pressing in a machine of like operation to an ordinary mangle. One intermediate process, consisting in filing the heads of the needles before the drilling of their 'eyes,' is a dusty process of limited extent and influence in the matter of health. Another is the polishing of the needles on emery-coated wheels.

The making of needles is not the only business of the Redditch factories. They are also occupied in a large way with the manufacture of fish-hooks, large and small, and of steel pins of many sizes. But the making of such articles possesses no novel sanitary features to be noticed; both the material used, the operation of grinding, and the lesser ones, the polishing and filing, being practically identical with what is met with in manufacturing needles.

The account of the nature of the business of needle-making prepares us to expect the prevalence of lung affections and of tubercular disease and scrofula, especially when, as just now noticed, to the incidents of the manufacture itself, are subjoined many extraneous conditions affecting health and life. Dr. Holland collected particulars of the age and causes of death of twelve grinders, deceased at Hathersage: forty-two was the highest age reached, and that by two only; four others lived to betwixt thirty and forty; the remaining six to between twenty and thirty. And nine out of the twelve perished from grinders' chest disease. This record is confirmed by the evidence given by Mr. Cocker, a manufacturer, before the Children's Employment Commission, printed in 1865.

Such was the state of things before the introduction of fans to withdraw the dust, an event which took place shortly after the time of Dr. Holland's visit.

Dr. Page, of Redditch, most kindly copied from the registers the number of deaths assigned to phthisis. During four of the years quoted, 1876, 1877, 1878, and 1879, he acted as medical officer of health, and I have selected the returns of those years for calculating its ratio to the population living in the town. The outcome is that, in every 1000 living, the deaths from phthisis were in each year respectively, 2·34, 2·84, 2·17, and 2·16. Again, its ratio to the total mortality stands, for the same years in order, at 12·16, 15·58, 11·24, and 9·63.

The returns made for 1882, 1883, and 1884 exhibit a greater reduction; but as the mode of registration pursued in these years does not differentiate phthisis from other chest affections and struma, as was done in the foregoing years, they cannot be profitably appealed to.

Just as happens with the trades of Sheffield, the introduction of youths, especially when not robust, to needle-pointing shops, is fraught with speedy breaking down of health and early death, if the occupation be persisted in. Moreover, the same statistical tables just quoted prove how extensively struma prevails in the Redditch district. Under the head of struma, Dr. Page included deaths registered as due to hydrocephalus, rickets, and marasmus; and, not to go into minute reckonings, the general induction is that they equalled about two-thirds of the deaths attributed to phthisis. Lastly, Dr. Page is strongly impressed by the prevalence of constitutional tubercular and scrofulous disease in the population of Redditch at large.

Phthisis and grinders' consumption, or asthma, do not stand alone as consequences of the trade of needle-making. Its first process, that of cutting the steel wire, has proved a fertile cause of abdominal hernia. The wire is received in coils containing numerous strands, which resemble wire-ropes. These are cut through by enormous shears having one blade affixed to the wall. Great force is required to accomplish the act, and as the workman, if unassisted, has to hold the coil, with the length to be cut properly gauged, in one hand, he

assists the other hand by pressing powerfully with the lower part of his body and thigh against the unfixed handle of the shears. This exertion subjects the abdominal wall to great pressure and strain, ending not unfrequently, in hernia. Happily for artisans, where steam-power is available, a machine has been invented to perform this simple process without manual labour.

Again, in pointing needles on the grindstone, as described, the workman, after gathering a multitude, and quickly bringing them into a row, grips them very firmly between his thumb and fingers, and, at the same time, presses (using some lateral movement in addition) the points against the stone, so as to expose the same extent of surface for each needle to its action. There is consequently a strain put upon the muscles of the hand, whilst great accuracy is required in the adjustment of the needles; the consequence is, that as in many occupations where certain muscles are overused, after probably many years of such labour, there ensue loss of power and atrophy, disqualifying the workman from further pursuing his business. The same excessive use of the thumb and fingers causes in old hands a coldness and numbness of the parts, felt most on first going to work. In the peculiar paralysis in question, electricity has proved useless as a therapeutical agent.

At the time I inspected the needle-works at Redditch, I brought away specimens of the dust collected from the 'dust-house,' and likewise from the bench of the grinder near the stone. On submitting them to microscopic examination, both were found to contain numerous angular particles of silica and black-looking fine, fibre-like and jagged particles of steel, for the most part with pointed ends. But these elements existed in very different proportions in the two kinds of dust. That from the bench, of a brown colour, exhibited only a few steel particles scattered among fragments of silex; whereas that obtained from the dust-house, of a very dark slate colour, was pervaded everywhere by the morsels of steel.

The great difference subsisting between the sorts of dust was much more precisely demonstrated by Dr. Page, who made a physical examination of them by magnets. By this

proceeding, after weighing his specimen of each, both before and after the abstraction of the steel, he found that the example got from the dust-house contained 96·15 per cent. of steel, and only 3·85 of silex; whereas the bench sand was made up of 94·8 per cent. of silex, with only 5·2 per cent. of iron.

The specimens were got from a factory where the arrangements for removing dust are the most efficient yet invented; and it is most gratifying to find that those arrangements are so perfect as to withdraw 96·15 per cent. of the steel particles thrown off in the needle-pointing, which would otherwise be diffused around the workman. Unfortunately, too large a proportion of the sand from the grindstones escapes removal; but it is to be remembered that its particles are larger and less pointed than those of steel, and that in the revolution of the grindstone they suffer chiefly a lateral dispersion; a fact shown by the position this siliceous dust occupies on the bench.

A comparison instituted between the dust of needle- and that of fork-grinding indicated a more abundant proportion of steel particles in the latter.

The ascertained compound nature of the dust in dry-grinding leaves it open to speculation which of the two ingredients, the stone or the steel, is more injurious. The spicular rugged splinters of steel look the more likely to make their way into lung tissue, and to cause irritation and lymph exudation. The two ingredients are at once discernible under the microscope; but amid the spicular and jagged atoms of steel are certain black globular concretions, which Dr. Sigerson has very appropriately likened to miniature cannon-balls. Their appearance suggests their construction from the minutest atoms of the steel by accretion whilst in a state of incandescence.

Metallic dust is an evil afflicting many other callings than those described; but its operation on the human economy is of the same character; the degree of mischief caused by it depending on accidental surroundings; foremost among which are the construction and ventilation of the working places.

Many forms of work pursued in engineering shops,—as

filing, polishing, and 'fitting' in general, are of a dusty character; but there is another occupation that follows, at no great distance, the Sheffield trades, in respect of the injury caused by the generation of metallic dust—viz., the business of *gun-making*. For this trade demands minute and high finish, and involves a great amount of filing and polishing. Desayvre made a special study of the condition of the men engaged in it at the great French Government factory at Châtelhérault. The consequences to health he details agree in general features with those of Sheffield grinders. Two forms are distinguished. The first, a state of dyspnœa, which may last several years, with cough and abundant mucous expectoration containing portions of dust. The chest assumes the barrel shape of true emphysema, with loud percussion-note and bronchial râle sat places; whilst at others the breath-sounds are obscure. The morbid features are those of industrial bronchorrhœa, excepting that in this occupation there is almost always an ulcerated condition of the mucous membrane. At this early stage, cessation from work will usually be followed by recovery.

In the second form, the cough and dyspnœa appear simultaneously. In the first instance the cough is dry, and after a time some spitting of blood occurs, and with it purulent expectoration, often mixed with blood, and also with calcareous concretions of different colours and consistence. The thorax is contracted and flattened rather than dilated; and, where there is percussion dulness, the respiratory bruit is obscure, and accompanied by various sounds, according to the condition of the lung. So soon as the expectoration grows purulent, the strength rapidly withers; wasting progresses fast, and the aspect of the patient is that of a person in consumption.

The pathological consequences of this pulmonary affection appear in the shape of small granules, varying from the size of small shot to that of a pea, and chemically consisting of silex, iron, and calcareous matter; of engorgement or consolidation of the lungs of greater or less extent, and, in the end, of caseous masses of varied density, or in process of softening. This, as Layet writes, may be looked upon as a true professional phthisis, devoid of tubercular lesion, and

not connected with heredity. It is of the same character as the lung mischief consequent upon metal grinding, stone cutting, quarrying, and mining, previously illustrated.

Gunsmiths appear in Dr. Ogle's statistical tables. They have the high comparative mortality figure of 1031, and their mean annual death-rate between twenty-five and forty-five is 10·62, and between forty-five and sixty-five, 25·78. These numerical results must, we consider, be looked upon as only roughly approximative. The subject need be investigated in the large gun factories of Birmingham and in the Government establishments, where a proper classification of the several branches of gun-making can be made, their several health conditions be estimated, and their consequences to the bodily frame be followed out. Surely what French physicians have effected regarding this occupation is worthy the imitation of English medical men.

Steel pen-making is an occupation respecting which I have obtained no special information. It is largely in the hands of girls who find in the operations of blank-cutting, piercing, and marking, suitable employment, without any drawback, except the sedentary character of the work and the risk of accidents to the fingers in working the machines. However, after the pens have passed through the several presses that cut, pierce, and 'raise' them, they have to undergo grinding to impart the requisite flexibility, each pen being separately operated upon. This proceeding necessarily gives rise to some metallic dust, just as does needle-grinding, though in a very much slighter degree; and unless arrangements be made to draw it away, it cannot fail to be injurious to the respiratory organs of artisans.

ORDER B.—*Dusts of Organic Origin.*

These are of two sub-orders, according as they are derived from plants or animals.

Sub-order I. *Dusts of Vegetable Origin.*

These are derived from cotton, flax, jute, hemp, cocoa-nut fibre, esparto and other grasses used in paper-making, from

the flour wheat, and of other species of corn, from hay, chaff, and wood, and from used-up materials composed of cotton and linen. The two first named exceed in importance all the rest, by reason of the very large number of individuals employed upon them in the processes of manufacture. These processes, while bearing a general resemblance, nevertheless differ sufficiently in character to justify their separate consideration.

§ 1. *The Manufacture of Cotton.*—Cotton, as imported in bales, enormously compressed by hydraulic power, is, although intermixed with seeds and other foreign matters, in a more ready state for manufacture than flax. Its preparatory processes are simpler, and the dust evolved by them less in amount and less injurious to health.

The first operation is to open out the bales, to sort and to mix their contents, so as to secure an average staple. As the bales are heavy, and the amount of work to be got through considerable, the mixers,—who are all males,—require to be possessed of considerable strength.

The next preliminary business is to free the cotton from all admixture of foreign substances. This cleansing is done by what are called 'opening' and scutching machines, which tear it apart and beat out the dirt. Women, in this department, are engaged in continually feeding the machines and spreading out the cotton on the 'feed table' before it passes through the blowing apparatus and enters the carding machine. In this work the women stand for many hours together and inhale more or less dust or 'flue' that escapes. In the carding engines the impurities that have escaped scutching are finally abstracted by a sort of combing, and the filmy mass drawn together into a 'sliver,' when it is ready for the 'drawing frame,' and afterwards for passing through a variety of complicated machines, whereby it is spun eventually into the thread or 'yarn' suitable for weaving.

This, to a cotton-spinner, very crude and imperfect account of the manufacture of yarn, will suffice to indicate to the ordinary reader that it is one productive of some amount of dust, and particularly so in the preliminary operations of sorting, mixing, and scutching. In the after-operations of

spinning, the presence of dust is in inconsiderable quantity, and of minor importance as a disease factor. Formerly, the preparatory stages were of a most dusty character, the machines not being enclosed; still, even with their highly-improved construction, a certain proportion of dust will from time to time escape, especially when, for one reason or other, the enclosing case has to be opened. And, notwithstanding all precautions, the air of a cotton-mill gets charged with some dust or flue, which exhibits itself on the machines, the ledges or shelves in the rooms, and upon the hair and clothes of the workers; and though the operatives themselves are insensible to its presence, it is quite perceptible to the taste and smell of the casual visitor, by a kind of dryness and stuffiness of the air, accompanied by a slight pungency.

But both the amount of dust and the existence of other objectionable incidents are largely dependent on the quality of the cotton used, as well as on the perfectibility of ventilation. Inferior, weaker, and more brittle cotton is more liable to breakage, gives off more dust, and requires for its working a more humid and heated air. In this fact we have an explanation of the differences in hygienic results noticeable in different mills. The lower-class cottons are more loaded with dust, and therefore attended by greater evils to health.

The revolving cylinder of the carding machine is armed with fine spike-like metal teeth, which, in course of a short time, become clogged by adherent waste fibres, and also blunted. Hence these cylinders have to be cleaned by a process called 'stripping,' and sharpened by one of 'grinding.' These operations are attended by the escape for a while of a dense cloud of dust, and, as they have to be repeated several times a day, they contribute largely to the dusty state of the atmosphere. To obviate these objectionable operations, attempts have been made, with more or less success, to make the carding cylinders self-stripping and self-sharpening. Moreover, for the general purpose of withdrawing dust from the rooms, exhaust-fans are now almost universally introduced, with vast benefit.

As already stated, the spinning department is pretty free from the evils of dust, but it has the drawback of a rather

high and somewhat moist temperature, required to obviate breakage. In summer the heat grows very high, and induces exhaustion, sweating, and debility; results the more felt because spinning entails nearly constant standing, or slight movements to and fro to follow the 'mule frames'—movements tiring by repetition and monotony, if not by physical effort. At the same time, the spinners lean forward in a bent posture to their work, and are apt to incur, after a lengthened period, spinal curvature to some extent.

What renders the spinning-rooms more insanitary than they would be otherwise, considering their general spaciousness, is, that the temperature is maintained night and day, and that all inlets for air are kept carefully closed. In consequence, there is not the necessary renewal of air for healthy breathing. Moreover, in such close rooms, the operatives acquire a particular sensitiveness to currents of air and to change of temperature, and are themselves opposed to most attempts at ventilation. Happily, these remarks are not so generally applicable as they were formerly, for the better recognition of what constitutes ventilation, together with the skill of engineers, has worked a great reform in the sanitary state of spinning-rooms.

Another incident of the spinning department is the necessity for unremitting attention in watching the multitude of threads passing over the revolving wheels and spindles, in order to detect and make good the rupture of any one of them, by a simple operation known as 'piecing.' This process is extensively committed to the hands of young girls, who acquire remarkable facility in its performance. Like attention is also called for in feeding the machines with fresh material, and the demand upon its exercise is necessarily augmented when more than one frame is to be attended to.

On leaving the spinning-room, the yarn passes into the hands of winders and warpers, and gets placed on the bobbins ready for the work of the weavers. In winding a considerable amount of fluffy dust or flue is given off, but the work, like that also of warping, is easy, though it requires alacrity of movement and quickness of sight. The latter operation, however, allows frequent intervals for sitting. It is followed by the process of sizing, which falls to the lot of male work-

men. This done, and the weaver's beam placed in position, the operation of weaving is begun.

Weaving-sheds are of vast dimensions, and, in some instances, hold a thousand looms. The noise in the winding and spinning rooms is very great, but in the huge weaving-sheds it is almost deafening. At the same time, the places are excessively hot; and the air is charged with moisture, and, when there is heavy sizing, with dust of china clay,—the same material as used in making pottery. Added to these insanitary circumstances are bodily exhalations of the workers,—breath and perspiration. The heat and moisture are necessary to prevent the undue breakage of the yarn in the act of weaving, and the more so where the yarn is of inferior quality and is heavily sized, to make it marketable.

The sizing of the warp is an essential operation, and formerly the material used was a mixture of fermented flour and tallow. The like is still in use where high-class cotton cloth is woven; but in most mills the sizing is charged with a very high proportion of china clay. Unlike the old-fashioned proceeding, the clay sizing of the present day is of itself a cause of disease; and, by requiring the air of the sheds to be kept very hot and at the same time moist, further adds to the unhealthy conditions. The moist heat is obtained by the injection of steam into the apartment and the closure of inlets admitting cold air.

It is therefore easy to realise the insanitary conditions under which weavers have habitually worked, and to understand the revolt of these artisans some years since against them, and their appeal to Parliament for protection and relief. The result was a special investigation of the hygienic state of cotton weaving-sheds, intrusted to Dr. (now Sir) George Buchanan, the recently-retired chief of the Medical Department of the Local Government Board, who issued a report in 1872. No material changes followed this action. In consequence of renewed representations inquiries were made by Dr. Bridges, Mr. T. Holmes, and Mr. E. H. Osborn; and some four years ago an active movement was started by the weavers themselves, which at length succeeded in inducing Parliament to pass a special measure to control the practice of clay sizing and to improve the sanitary conditions of weaving-

sheds. This measure is entitled 'the Cotton Cloth Factories Act, 1889,' and, to borrow the words of the late Chief Inspector, Mr. Redgrave (*Report*, 1890, p. 58), has for its object 'to regulate the temperature and humidity of the atmosphere in the parts of factories in which the weaving of cotton cloth is carried on, and in which humidity is produced by artificial means. The schedules of the Act contain tables of temperature and humidity by which the state of the temperature is to be regulated;' and, to fulfil their requirements, a record of the state of the atmosphere has to be made twice daily.

As it was found that after a while the sized cloth became yellowish and specked with mildew, certain salts were added to the dressing for the purpose of preventing such untoward results. The salts chiefly employed are chlorides of zinc, magnesium, and calcium, with a certain proportion of sulphate of magnesia. The weavers advanced the statement that arsenic and possibly other active poisons were present in the sizing, but this was negatived by the Government chemical experts who tested that substance. Other complaints more justly made were, that the heat and the sweating induced by the steamy sheds caused great prostration, loss of appetite, impaired digestion and vertigo, proneness to take cold and to contract inflammatory diseases of the chest, and rheumatism.

The general truth of these complaints was indisputable; though it might be justly averred of them that, in no inconsiderable degree, their origin may be assigned to the thoughtlessness of the weavers themselves, who habitually quit the heated sheds for the external air, in all weathers, with little or no attention to additional protection by clothing. In like fashion, they too frequently leave their homes in early morning insufficiently clad and shod, and with empty stomachs, awaiting the brief half-hour for breakfast, to eat a hurried meal of poorly nutritious food in the shape of hot weak tea and bread and butter. This series of accidental conditions will adequately explain the frequency among them of dyspepsia, anæmia, and general debility; of colds and chest inflammations, and of rheumatism, apart from circumstances really belonging to their employment.

Weavers are of both sexes and of all ages, from early

youth to old age. One adult and skilled weaver will undertake three or four looms, having a helpmate called a 'tenter.' The physical labour of a weaver is small, but his work calls for constant watchfulness and care; for neglect to remedy a broken thread in the warp seriously deteriorates the cloth woven, and for the mishap the operative has to suffer in loss of wage.

The greatly-increased efficiency of modern machines has reduced the liability to disease and accidents, and advanced the material prosperity of cotton operatives; and though the increased velocity of machines has been accused of the production of evils to health, the fact has escaped demonstration. Nevertheless, I cannot dissociate such tremendous velocity of movement, which has to be minutely watched, from the idea of strain upon nerve-power.

To summarise the incidental causes of ill-health among cotton operatives:—they are, dust from the cotton itself in the early processes of manufacture; heat with more or less watery vapour, combined in the weaving department with dust from the Cornish clay employed for sizing; long standing, and a stooping posture in the spinning and doubling department; monotony of work; continuous strain upon the attention, and excessive noise with vibration of machinery. To these must be added vitiated air from excessive consumption of gas, from overcrowding, and general defects of ventilation. And it is no wonder that accidents abound, considering the extent of machinery, the velocity of movement, the proximity of machines to each other, the loosely hanging gearing, and the liability to the loosing and flying off of some parts of the machines. This last is an accident of frequent occurrence in the case of the shuttles of power-looms, which from the elevation at which they are thrown off, are oftener than not the cause of severe injuries to the eyes. To guard against this misfortune, many ingenious contrivances have been invented, and it is fair to expect that ere long some of them will be found a perfect success.

Minor accidents to the hands and fingers arise from spinning and other machines; and a high stature and abundant hair and headgear have, from time to time, led to women being caught by the belts or straps and losing

portions of scalp, and even life, when lifted and whirled among revolving wheels.

We shall hereafter see that, if in general features the cotton manufacture bears a resemblance to that of woollen, it is in hygienic particulars considerably more unhealthy. For instance, the dust of wool is less irritating to the respiratory passages; clay-sizing is not practised; and overheated rooms are an exception, whilst free access of air is needed in most departments.

The more observable effects of cotton-spinning on the general health are anæmia and an aspect of debility, of care and anxiety, not consonant with the age of the workers, who are mostly females, and young. Conjoined with these, and dependent largely on long standing and work in hot and moist apartments, are uterine derangements of various kinds. To long standing also is due the occurrence of varicose veins and ulcers, and of flattening of the arch of the feet.

The special major evils of the cotton manufacture belong to the respiratory system. The dust of cotton is an irritant to the pharynx and larynx, where it speedily produces a feeling of dryness and huskiness. If inhaled longer, it reaches the bronchi, and sets up cough with white mucous expectoration. The cough will be for years chiefly a morning phenomenon on first rising, but it is also induced upon leaving the warm workroom. Fine fibres of cotton are found, on microscopical examination, in the sputum, and as these make their way into the pulmonary tissue, they set up morbid action, resulting in increasing density of it on the one hand, and of emphysematous expansion on the other. These morbid changes are accompanied by dyspnœa, wasting, and debility, but rarely with hæmoptysis; and together constitute a group of symptoms not inappropriately termed 'industrial phthisis.' Moreover, intercurrent diseases of the lungs, such as acute bronchitis and pneumonia often arise and terminate life; and true tubercular phthisis is no uncommon cause of death.

Hirt states that women suffer in a higher ratio than men from the insanitary consequences of the manufacture. In the matter of numbers employed, they are certainly far more numerous than men: a fact to be kept in view in statistical records of the occupation.

The fact must not be lost sight of that the grinders who sharpen the carding machines breathe a mixed dust of cotton and steel, and of the emery powder used; and, as might be anticipated, suffer more seriously than the true cotton workers.

It is singular that in this country, where cotton-spinning is carried on on a scale surpassing that found in any other, there is a complete dearth of information respecting the morbid anatomy of the disorders due to the work. Indeed, we have not discovered one record of the post-mortem appearance of an old cotton-worker's lungs, and have to rely upon foreign observers for what has been ascertained on the subject.

Statistics of Cotton Operatives.—By the great kindness of Dr. R. C. Brown, one of the physicians of the Preston Hospital, I am in possession of the returns for six years of that Institution, showing the number of operatives actually at work in the trade who received medical attention as in- and out-patients. By taking those two descriptions of patients together, a more correct inference is to be reached respecting the prevailing diseases than if out- or in-patients were taken separately. Surgical maladies are excluded from the returns in question.

From the register of maladies it appears that of 1415 patients, 739 were weavers, and 676 workers in other departments of the cotton manufacture, including winders, spinners, reelers, carders, mill-hands, and grinders, with some other mill-artisans, few in number.

The following table shows at a glance the comparative frequency of the several most important diseases in the case of weavers, and of those following the several other branches of the occupation, and who, for convenience sake, may be called machine-room workers:—

Weavers (739).	Per cent.	Machine-room Workers (676).	Per cent.
Phthisis, . . .	9·87.	Phthisis, . . .	11·90.
Bronchitis, . .	32·34.	Bronchitis, . .	31·30.
Varicose veins and ulcers, . . .	11·23.	Varicose veins and ulcers, . . .	6·80.

Weavers (739).	Per cent.	Machine-room Workers (676).	Per cent.
Rheumatic affections,	7·70.	Rheumatic affections,	11·68.
Uterine disorders and displacements,	8·24.	Uterine disorders and displacements,	8·43.
Neuralgia, . .	2·84.	Neuralgia, . .	4·43.
Throat affections, .	1·89.	Throat affections, .	2·51.
Renal diseases, . .	2·57.	Renal diseases, . .	2·66.
Epilepsy, . . .	1·49.	Epilepsy, . . .	3·40.
Heart-diseases, . .	2·71.	Heart-diseases, . .	5·32.
Dyspepsia, . .	16·50.	Dyspepsia, . .	21·00.
Debility, . . .	7·57.	Debility, . . .	9·17.
Anæmia, . . .	2·43.	Anæmia, . . .	2·50.

By way of comment on the foregoing table, I may observe that the proportion of cotton-weavers suffering with phthisis is smaller than that of operatives in the other branches of the cotton manufacture; a circumstance I should not have looked for, inasmuch as the sum-total of the conditions of the weavers' labour strike me as the more unfavourable to life. However, there are facts that help to explain this matter. The average age of weavers is greater than that of other cotton hands. Among the machine-room operatives are many young persons; consequently a larger ratio of individuals of the consumptive period of life. Again, the latter class comprises the workers occupied in the preliminary processes, carding and sorting, and the male hands engaged in grinding—branches of work particularly inimical to the lungs on account of the dust generated.

Bronchitis shows a slightly higher rate of prevalence among weavers, and varicose veins and ulcers a decidedly higher one. On the other hand, the machine-shop operatives get more rheumatic affections, heart-disease, epilepsy, neuralgia, throat attacks, dyspepsia and debility. So far as rheumatic disorders are concerned this is an unexpected occurrence, considering the greater heat and moisture to be found in the weaving sheds.

An analysis of the ages of the mill-operatives shows that sickness prevailed between 15 and 20, in 13·50 per cent.; 20 and 30, in 24·64 per cent. of the patients treated; between 30 and 40, in 25·68; and between 40 and 50, in 18·41.

In the matter of the mortality of cotton-workers, Dr. Ogle's statistics do not afford precise information; for he has grouped cotton and linen hands together—two kinds of textile industry differing very considerably from one another in the material used and in the operations of manufacture followed.

Further, if we desired an accurate estimate of the effects of the cotton manufacture upon health, we could not rightly use the returns of sickness from mills at large, but ought to examine the sanitary conditions of mills in connection with the kind of cotton and the machinery in use, and the comparative ages of those they employ.

Mr. Inspector Redgrave, in his excellent *Report* of 1872 (p. 48), has the following remarks. He is speaking of the scutching, blowing, carding, and spinning rooms, and observes: 'The condition of these departments will depend not only upon the ventilation of the rooms, but upon the kind of cotton used, and whether the machinery be old or new. In a factory working Sea Island cotton, spinning fine numbers, and using modern machinery, the carding-room will be comparatively free, but the spinning-room will be maintained at a very high temperature. In an old mill working Indian cotton and spinning moderate numbers, the carding-room will be filled with dust, but the spinning-rooms will be comparatively cool.' . . . 'Then, again, a cotton-mill in the heart of an old and densely-populated town, in an atmosphere of smoke, cannot compare with a factory in a country district with the free air from the hills playing round it.' 'Then, again, it is necessary to consider the kind of machinery used; some forms obviating the production of dust and other evils existing in others.' Proceeding, he says: 'In connection with the differences of the nature of the labour required in the working of different materials upon different machinery, there are other striking contrasts which illustrate the extreme dissimilarity of working in different mills.' Thus, 'it would be found in a cotton-mill in which Sea Island cotton was spun, that the attention of the operatives was not near so close as in a mill in which Indian cotton or waste was spun. The fibre of the Sea Island cotton is longer and stronger than that of the Indian, and consequently does not

break nearly so often. The actual labour of the cotton manufacture would thus differ very materially in different mills.'

Mr. Redgrave then goes on to compare cotton with flax, worsted, and jute, as to their behaviour severally under the different processes of manufacture, and points out that all these latter materials have longer and stronger fibres than cotton, and that, consequently, the drawing, roving, and spinning, go on with such precision as to call for small attention on the part of the females employed, and even admit of their sitting to read or do needlework whilst attending to the machines.

Accidents in Textile Trades.—The proportionate number of accidents in the great textile trades was the subject of a Parliamentary return in 1870. In the cotton industry the rate was 1 accident to 176 employed; in the woollen, 1 in 230; in the worsted, 1 in 433; in the flax, etc., 1 in 190; in the silk, 1 in 1074. Taking the whole group, the common ratio was 1 to 210. Mr. Redgrave compared these returns with those made twenty years previously, when the gratifying outcome was, that accidents had decreased from 1 in 143 to the above-named rate of 1 to 210.

Gassing.—There is a supplementary department of textile manufacture in which the operation known as 'gassing' is carried on. It is resorted to when a fine smooth or even yarn is required, and consists in the rapid passage of the yarn through a small flame of gas, whereby the minute rough or fluffy projections on its surface are burnt off. Of necessity the velocity with which the yarn is drawn through the flame is very great, and effected by special apparatus calling 'gassing-frames,' disposed on long benches, and fed by a free supply of gas, or of gas mixed with air. This process produces overheated air, with much dust derived from the particles of scorched cotton; but the extent of the evil will depend largely upon the spaciousness of the room and its ventilation. In some gassing-rooms the dust pervades the air sufficiently to produce a haze, and the casual visitor is cognisant not only of the smell of scorched organic matter,

and of unconsumed gas and gaseous products, but feels his breathing hurried and thickened, and his throat irritated and dried, giving rise to a sensation that ends in cough.

But, as above implied, it is not in all factories that gassing is done, and in most of them it is carried out on a comparatively small scale. It is usually the employment of women, who, when inured to it, appear not incommoded, though they look fagged and pallid, and, as I satisfied myself, sooner or later become short-breathed and bronchitic. The remedy against this evil is ample space and the introduction of exhaust-fans to withdraw the dust, whilst fresh air is introduced from without.

This notice of 'gassing' will sufficiently serve for illustration in whatever division of textile manufacture the process is employed. For it is one carried on in the case of silk and of woollen materials, and also in lace-making. When applied to the production of a particular woollen fabric, it goes under the name of 'genapping.'

Lace-making was in former times handiwork; and although it partially remains so, particularly the branch of it known as 'pillow-lace' making, yet it claims a place among the textile manufactures of the kingdom, by its transformation to an employment wherein machinery of an elaborate character is an essential element, and associated labour in factories the rule. Its chief seat is at Nottingham, but it is a trade that unfortunately has suffered great adversity in consequence of foreign competition.

From a purely hygienic point of view the decay of the trade is not so regrettable, for it acted injuriously on the vitality of the population, as expressed by the high ratio of phthisis and scrofula among its followers. Its chief incidental features are sedentary work and heated shops.

Referring first now to (*a*) *Machine-made* lace, it presents three primary divisions or departments, viz., making by the machines, finishing it when so made, and mending. The finishing division likewise presents several sub-divisions, such as dressing and gauffering, bleaching and dyeing. Mending precedes dressing, and is called 'rough-mending;' it requires great skill with the needle and close attention;

these qualifications being in greater request when black-lace is dealt with. The dressing or 'dress' consists chiefly of starch; and is spread over the material by brushes or else the lace is dipped into it. When the latter proceeding is resorted to, the excess of the dressing is pressed out between rollers. Following upon this is the drying of the lace, stretched for the purpose upon long frames, placed in large rooms, highly heated, mostly to a temperature of from 80° to 95°, and apt to be further raised by summer heat. The dressing-rooms are served by young females. The lace when dried requires many minor operations, ending in putting on facings of coloured paper. The patterns formerly worked by hand are now produced by machines, but require trimming by scissors, called 'clipping' and 'scolloping.'

A particular branch of the lace business is 'bonnet-front' making, which is done by a gauffering machine, heated by gas. It is a division of the occupation regarded on all hands as very unhealthy, chiefly on account of the very great heat connected with it, and, in less measure, of a sickly smell evolved. The 'finishing' of cotton lace entails a higher temperature than that of silk-lace. The same fact applies when 'Paris' dressing is done. The presence of a large surface of moist tissue and the elevation of temperature necessarily imply a more or less humid atmosphere and free perspiration.

Fortunately the admission of fresh air is permissible at times from open windows. For the most part finishing-rooms are heated by hot-water or steam pipes, though in some factories open fires are found in the making-up departments; the air is dry, and the making-up machines, heated by gas or by steam pipes, render it very hot, especially when several of them are situated in the same apartment.

We are indebted for most of the preceding particulars respecting the processes of lace-making to the excellent report of Mr. J. E. White and the evidence collected by him from various factory occupiers, published in the first *Report of the Children's Employment Commissioners*, 1863 (p. 282 *et seq.*). We gather from it that the active factors in provoking disease are great heat, both dry and moist, prolonged standing, or sitting in a stooping position; a very

large consumption of gas; brilliant light and minute handiwork; often air deteriorated by the breath of many workpeople and deficient ventilation; the dust, heat, and bad air from gassing, and the liability to colds from extremes of temperature, aggravated by the carelessness of the operatives themselves. At the date of the report quoted, other potent disease-producing agencies prevailed in unduly-extended hours of work, irregular meal times, scanty wages, poor food; besides circumstances outside the mills unfavourable to moral habits, neglected education, and last, not least, the employment of children of tender years, beginning at the early age of five.

Since the period in question the provisions of the Factory Act as to education and age, and to the duration of employment, the prescription of meal hours, the regulations as to ventilation and the cubic capacity of workrooms, have come into force, and materially improved the hygienic condition of lace works and of those employed in them.

The cognisable effects of the foregoing conditions were, anæmia, general debility and mal-nutrition, dyspepsia, constipation, frequent faintings in the hot rooms, with hysteria, amenorrhœa or menorrhagia, chorea, rheumatism, headaches, vertigo, scrofula, pulmonary inflammations, and phthisis.

All these ills of lace-making abounded in a higher ratio in the cottage homes and in the 'lace-schools,' conducted by mistresses who catered for work at reduced rates of payment. In these private houses all sanitary defects, especially overcrowding, were far worse usually than in the factories. Moreover, children from five and upwards were, relatively, considerably more numerous than those of mature years.

In the hot dressing-rooms the standing posture was kept up for long hours, and here were found girls grown into womanhood at fourteen and fifteen years of age, subject to diseases consequent on rapid and weakly development, to amenorrhœa, chorea, hysteria, scrofula and phthisis (*op. cit.* p. 240).

The high death-rate of young children was a particular subject of investigation in connection with the lace trade in Nottingham. An explanation of it was found in the youthful age of many mothers, in the prevalent custom of returning to work at a very early period after confinement, leaving the

nourishment of children to care-takers; in improper feeding in the effects of poverty, and lastly, in a high ratio of illegitimacy.

Again, lace-making is an occupation damaging to the eye-sight; inducing disorders of accommodation, short sight, with the lesser evils of tumefaction of the eyelids and congestion of conjunctiva. The contributory causes are the minuteness and accuracy of the work, the long hours it is carried on, and especially when artificial light is largely employed.

We have mentioned the practice of 'transferring' patterns by means of finely-powdered carbonate of lead in France and Belgium. This poisonous material is selected because it retains its whiteness, whilst most other powders available for the purpose grow, in course of time, yellow. For the same reason the lead powder is used when lace is arranged in layers in boxes for sale to throw up the pattern and to preserve its whiteness. To this mischievous trade-practice Blanchet attributed some of the amaurosis he remarked among lace-makers; and doubtless he was right, for we well know that lead sets up optic neuritis as one of its many evil consequences. The Belgian government tried unsuccessfully to abolish the practice. The sulphate was tried as being a less poisonous salt, but it was found to become yellow after a while.

Lastly, some few lace-workers are subjected to the inhalation of carbonaceous dust when employed in the gassing-room: a cause of suffering more fully entered into on a preceding page.

(*b*) *Pillow lace-making.* In this the evils flowing from heat do not exist, but rather those attributable to cold and moisture, particularly in foreign countries. The highly-prized laces of Belgium, often produced by nuns confined in the convents of that kingdom, are only workable where the air is cool and damp; and we read of underground cellars or cells as the places of their manufacture.

In England such exceedingly fine lace is seldom manufactured, and the workers usually live and labour at home; young ones being taught from a very early age in schools under lace-schoolmistresses.

The hygienic conditions of the occupation are essentially

those of long confinement in the sitting posture, in a more or less constrained position, insufficient air-space in the rooms for the number employed, overstrain of vision, and want of outdoor exercise and diversion, and, too often, highly insanitary surroundings.

The same list of consequences obtaining among lace-dressers and finishers here prevail also; consumption holding a leading position in the mortality tables. Moreover, as the remuneration for pillow-lace making is most meagre, all its unfavourable influences are enhanced by the poverty of the people, their poor food and wretched homes. It is not surprising, therefore, to learn from Dr. Greenhow that the population of English lace towns has a stunted, ill-nourished appearance; that slight spinal curvature is common, and the chest almost always flat and ill-developed; its posterior measurements exceeding the anterior in all the cases where they were taken (*Report* 3d, p. 179-181).

Layet (*op. cit.* p. 258) sketches the state of the trade in France, using chiefly the account given by Thouvenin, of Lille, where it is largely carried on. He remarks on the excessive destruction of life by phthisis and scrofula, on the eye-disorders produced, and on the stiffness, and, in old hands, the immobility of the lower limbs caused by persistent sitting. The explanation he finds in the extended hours of work, in the humid and often underground workrooms, in the poor food alone attainable, in miserable homes, and early apprenticeship. Quoting Thouvenin, he says that, of 100 girls, from five to six years of age, who are apprenticed for the usual period of four years, at least one-half on reaching fifty were crooked in the back, or suffered eye-diseases, amaurosis, or myopia, or absolute blindness, and were all pallid and emaciated. The ratio, moreover, was found to increase with the progress of age.

§ 2. *The Manufacture of Linen.*—The conversion of flax into linen is probably the oldest occupation of mankind, next to pottery. The chief centre of the manufacture within the United Kingdom is Belfast and some neighbouring towns; and the best account of its health aspects I have knowledge of, occurs in some scattered papers by my late friend,

Dr. C. D. Purdon, who, from his connection with public medical institutions in Belfast, and his long tenure of office as Factory Certifying Surgeon, was most advantageously placed for investigating them.

As in other textile trades, it is in the early or preparatory processes that the evils of the manufacture are chiefly found. By the kindness, and under the escort of Dr. Purdon, I had the opportunity of seeing for myself the many processes concerned in the production of linen, and several occupations springing out of that manufacture.

When the flax is harvested, the first operations are directed to the detachment of the brittle, woody matter inside from the true fibrous tissue of the exterior of the stems, which alone is of value. This is done by steeping the plant in pits or tanks containing water; or, more rarely, by leaving it to be weathered on the surface of the ground. This proceeding is called 'retting.' In England, where time is more valued, the process of separation is accelerated in hot-water tanks, and conducted in special buildings called 'retteries.'

The decaying of vegetable tissue in the shallow pits is accompanied by noisome smells; but, so far as can be discovered, these stinks produce no ill-effects upon the surrounding population, who are well used to them.

After retting is completed and the flax roughly dried, it goes to the 'scutch' mill, where it is crushed between rollers into a fibrous mass, with the evolution of a vast quantity of dust. This dust proves very injurious to the breathing of the men employed; but happily for them, the damage done is somewhat retrieved by the circumstance that scutching is carried on in the flax-producing districts for only about a month in the year, ceasing when the produce of one harvest is prepared for the market until the next one is gathered. In the meanwhile, the labourers are engaged in the healthful pursuits of agriculture.

Until of late years scutch-mills were of the rudest construction, and driven by water-power, without any efforts made to diminish the production of dust. Such mills are now almost everywhere displaced by improved structures, and the adoption of superior machinery moved by steam-

power. The result is that the evils of scutching are reduced almost to a minimum.

The scutched material next passes into the hands of labourers called 'roughers,' who roughly comb it to rid it of extraneous matters, and lay the fibres in a fairly regular fashion; and afterwards gather them into bundles or 'stricks,' prior to their being fixed between the clams of the 'heckling' machine. These clams, when charged, are made to travel between the vertically-fixed combs or 'heckles' of that machine, whereby the shorts are separated from the long fibres, and disposed in lengthwise parallel series. By this operation more dust is removed from the material, and gets diffused around.

'Boys are employed' (we here quote the excellent account of Dr. Bridges and Mr. T. Holmes, *op. cit.* p. 22) 'to fix the stricks in the clamps, to replace them, to arrange them together when thoroughly machined, and to tie them up in rough bundles in readiness for the next process. Their work is laborious and continuous, and they soon suffer from spasmodic attacks of cough, provoked from the abundant dust thrown off by the heckling. This dust is a very fine soft and palpable powder, far more granular than fibrous in constitution, and contains thirteen parts of silica in one hundred.'

When the heckling is complete, a second hand-combing is done by men, followed by the operation of sorting and of light combing by girls.

To allow the escape of the dust, the heckling is carried on in shops with open windows, but warmed by steam-pipes. Of recent years attention has been more seriously directed to prevent the escape and diffusion of dust from the heckling machines by enclosing them as far as possible, and to withdraw the dust from the workrooms and from the machines themselves by exhaust fans.

The long flax, now separated from the short or tow, is known as the 'line,' and has to undergo certain preparatory processes to form a 'sliver.' These processes again are attended by the evolution of some fine dust. Drawing and roving follow, and the sliver is then ready for spinning. On the other hand, the short flax fibres or tow have to be

returned to the carding machine, and thereby brought forward to the state of 'line' fitted for spinning.

The carding of tow is unfortunately a very dusty operation, and falls to the lot of women; and to lessen its ill effects, it is common to blow occasionally jets of steam into the apartment, where it goes forward.

In the wet-spinning of flax and tow, the line or 'roving' is drawn through a trough of hot water, and in consequence the spinning-rooms are hot, and pervaded by moisture. The extent to which these conditions prevail depends on the spaciousness of the rooms, their ventilation, and the amount of steam injected; and also on the quality of the flax in use, the coarser varieties requiring more heat and moisture, and being also more dusty.

Wet-spinning is attended by the further misfortune, that it wets the women working at the frames, and entails a more or less sloppy state of the floor. This exposure of the workers to heat and moisture, wet clothes and wet feet, brings about a relaxed state of body, rendering it more liable to colds, inflammations, and rheumatism.

Such, originally, were the evils of this business that legislative measures were called for to lessen them; and the Factory Act now prescribes the provision of splash-boards, and the wearing of aprons by the women. To render the last device effective, the use of waterproof has been recommended.

In the opinion of those best able to judge, the hot and steamy air of wet-spinning rooms is not unavoidable, but remediable by attention to proper ventilation, and by securing sufficient cubic capacity and elevation of roof.

It is necessary to note that flax and jute may also be spun dry; but this proceeding is not carried on in Belfast for the making of linen, but is almost peculiar to the Scottish factories in Dundee and neighbourhood, where a coarse flax and jute are employed in the manufacture of sail-cloth and sacks. But this process, though free from the disadvantages of water and steam, is attended by the more pernicious one of greater dust.

The business of linen-weaving calls for no special notice,

for it has no unhealthy characteristics in itself, and the practice of clay-sizing has not invaded the manufacture. Some sizing is, indeed, used; but its components are devoid of any injurious qualities. Moreover, in place of heat and moisture requisite in cotton-weaving sheds, there is a demand for cool air and free ventilation in linen-weaving shops.

A high temperature is not confined to the spinning-rooms, but likewise prevails where the dressing and sizing of the woven material are carried on. It is the occupation of very few, and these adult men; but its destructive influence upon health is so fully recognised that none are put to the work before eighteen years of age, and considered free from chest disease. The heat in those places varies from 90° to 120°, and those who perform the work in them are stated to become incapacitated for it in about sixteen years by reason of the onset of pulmonary diseases.

Flax dust generated in the various operations is locally known as 'pouce,' and those affected by its inhalation are described as 'poucey,' words of French derivation. It has the unenviable quality of being more pernicious to the respiratory organs than that of any other textile material, except its congeners, jute and hemp.

The most prominent result of its inhalation is the production of severe dyspnœa; the degree of which, however, does not stand in direct relation to the extent of lung lesion, and evidently partakes of a nervous character.

Another quality of flax dust is, that it is more difficult to get rid of by expectoration than other textile dusts. In advanced cases the cough and dyspnœa are very urgent and distressing, and paroxysmal in character. The seizures are more severe on first rising in the morning, and again after quitting the warm mill. By their violence they often compel the sufferer to stagger and to clutch at any object near at hand for support; and occasionally the paroxysm of cough does not end without vomiting, or even expectorating of blood.

Chronicity is the characteristic of the chest disease, which sooner or later declares itself in the haggard, wasted features, in general emaciation, in the rounded shoulders, and in the tottering gait of its victims.

The effects of flax dust on lung tissue are well seen in Dr. Greenhow's specimens (Nos. 1281 and 1282). The morbid features of these specimens are thus described in the Museum Catalogue (Specimen, No. 1281):—'Portions of lungs deeply pigmented with patches of circumscribed consolidation, produced by yellowish inflammatory exudation into the air-cells. On microscopical examination, the walls of the air-vesicles were found thickened and infiltrated with black pigment, and the pulmonary tissue in the solid portions was intersected by adventitious fibrous bands, studded with black pigment granules, and the air-vesicles themselves filled with exudation cells and oily granular matter. The patient was a flax-dresser, aged forty, who died from chronic pulmonary disease produced by the inhalation of dust' (vide *Pathological Society's Transactions*, vol. xx. p. 48).

The other specimen (No. 1282) is that of a 'portion of lung, deeply pigmented with patches of consolidation, presenting very similar characters to the last specimen. From a flax-dresser, aged forty-nine, who died of chronic pulmonary disease produced by the inhalation of dust' (vide *Pathological Society's Transactions*, vol. xx.). In both these cases an analysis was made of the ash produced by incinerating the lung. In the first case, 100 grains of dried lung gave 3·881 grains of ash, of which 0·227 grain was silica. In the second, 100 grains of dried lung gave 2·609 grains of ash, of which 0·47 grain was silica. In both alumina and iron were present.' (p. 158-159).

The structural details are more fully given in the excellent papers Dr. Greenhow contributed to the Pathological Society, and published in the twentieth volume, with accompanying plate in illustration.

Speaking of machine-boys, Dr. Purdon states that in a great number of instances they have to give up the calling and take to other occupations. Yet, when once become 'poucey,' they suffer cough and dyspnœa in cold weather, and probably in the end die of phthisis. 'The number that died of phthisis in one year, during the time they were in the factory class (*i.e.* in the employment), was six per thousand, but as numbers linger out a diseased existence in other callings, only to terminate in death, far more than six per

thousand get the seeds of their death in the machine-room of a mill. At seventeen years of age, should his health be such as would enable him to continue working, he either becomes a rougher or sorter, and these two classes generally suffer from frequent attacks; when about thirty years of age their appearance begins to alter, the face gets an anxious look, the shoulders become high,—in fact, they become prematurely aged, and the greater number die before forty-five years; many, as in the case of machine-boys, are compelled through chest affections to seek for other means of support, so that it is a very rare occurrence to see a heckler over sixty years of age that has always been employed as such. In my mortality tables the deaths from phthisis and chest affections were 11·1 per thousand in one year; but, as mentioned before,' the dust is accountable for many more deaths, happening among those who have exchanged work in the mills for some other employment.

The same physician adds, the class that suffers most are those employed in preparing and carding, who are, for the most part, females. A woman who starts carding at seventeen or eighteen years old, begins to break up at thirty; and the average duration of a carder's life is about forty-five years. In the operations antecedent to carding, the death-rate was thirty-one in the thousand. The most fatal branch of flax labour is that where the 'long line or cut line' is spread, as the dust is so fine and of such an irritating character that it almost invariably produces lung disease.

Painful experience has taught flax operatives engaged in the preparatory branches of the work the advantage of changing their employment, and of taking up one or other of the comparatively harmless trades of winding, reeling, and weaving.

The girls and boys employed about the spinning-rooms are locally known as 'doffers.' Considering the hot and vapoury atmosphere of these rooms, and the unavoidable presence of some amount of organic dust, it is not surprising that the young hands when they first enter on their work—which is chiefly that of supplying 'bobbins' to the spinners, and calls for much active movement—suffer some general disturbance of health. This disturbance is known as 'mill

fever.' It attacks them within the first few days of employment, and is looked upon by the workpeople as a 'seasoning' which has to be passed through. It is ushered in by chills, nausea, and vomiting, quickly followed by headache, thirst, and heat of skin; and is, in short, a true febrile disorder. After from two to eight days it spontaneously disappears, without medical intervention, leaving the patients weak and languid.

A similar temporary derangement, little regarded, befalls the young hands on first entering other textile factories; but not, we believe, of equal severity with that observed in flax-mills. This fact may be gathered from the statistics given respecting the cotton manufacture.

In the operation of spinning a considerable quantity of oil, of some kind or other, is used to lubricate the machine, and is, in the opinion of some physicians, the active agent in producing one or more forms of cutaneous eruption. The young doffers are its especial, but not its sole victims. It appears on exposed parts, chiefly the arms; is of a papular character, and attended by prickly heat and irritation. It has been variously named lichen, acne, and eczema.

What we conceive to be the self-same disease is called by M. Leloir (*British Journal of Dermatology*, 1889) 'Folliculitis and Perifolliculitis of Spinners.' He would, however, differentiate the eruption so termed from the one above described, chiefly on account of its location on the lower extremities and, for the most part, among men. He regards it as a product of irritation from oil, usually mineral, intensified by neglect of cleanliness of person and of the clothing, and by the hardness of the corduroy trousers commonly worn by the male operatives. The sebaceous follicles are its primary seat, and the individuals most severely attacked are of strumous or lymphatic constitution, and have the 'cutis anserina.'

It is, says M. Leloir, a folliculitis ending in perifolliculitis. The first stage of distension by sebaceous matter is followed by the formation of inflamed, red papules, having a central opening, which shortly becomes surrounded by a crust. It is accompanied by more or less pruritus, and may be mistaken for scabies.

The question of the character and cause of these erup-

tions of the skin among flax-workers has been re-opened by Dr. Lefebvre, who undertook, by request of M. Leloir, to re-examine it. His results appeared as a thesis, published at Lille in 1889, and were analysed in the *Journal of Dermatology*. He carried out 400 observations, and instituted four forms of eruption, respectively called Eczema erythemato-vesiculosum; E. vesiculo-papulosum; E. squamosum; and E. lichenoides, this last prevailing in nine out of ten cases. The lesion begins on the palmar surface of the thumb and index finger, whence it usually extends to the other fingers and the palm of the hand, nearly as far as the wrist. At times it spreads to the dorsal aspect of the fingers and hand. The spinners of tow and coarse yarn present the most diffused forms.

The writer regards the water as more active in setting up the eruption than the flax itself, and believes stagnant water in which the flax has been soaked for a length of time, and which is undergoing a fermentative process, to be the most hurtful. Where there is constantly renewed or running water the disease is very rare. The eczema, likewise, affects at times the feet of the workmen, which come only in contact with the water drained from the flax.

Before going further it is right to mention that this eczema of flax-workers was attributed by Dr. C. Purdon to flax water, as the French physicians maintain. His son, Dr. H. S. Purdon, physician to the Belfast Skin Hospital, however, regards it as rather due to the oils used in the spinning-rooms.

There is a fondness on the part of dermatologists, as of botanists also, to multiply species out of varieties originating in constitutional and accidental circumstances, and we all know how varied are the features of eczema even on the surface of the same individual. Hence I am unwilling to admit the several forms of skin affection happening to flax-workers, as described by the two French authors, to be distinct species of eczema, and worthy of the elaborate nomenclature accorded them. In fact, I look doubtfully upon the follicular malady of M. Leloir as a distinct species, being disposed to refer its differential features to accidental causes and to the peculiarities of the skin structure where it has

its seat. In short, its special features seem explicable by the operation of dirt and friction coincident with its situation and onset, by the denser epidermis and the greater development in males of hair on the skin, in the follicles of which the disease has its origin.

However this question be solved, there is evidence of another and distinct skin disease, in which pustules, resembling those of small-pox, are developed. This more serious affection Dr. Purdon associated with the use of certain kinds of Russian flax. Unfortunately, he has given no account of its symptomatology to enable us to form an opinion as to its causation; but the idea suggests itself that the malady may have its origin in some septic matter, and be akin to other diseases accompanying certain other imports from Russia, such as the Van wool.

Yet another skin trouble attends those flax-workers who have to handle the yarn whilst bleaching; for the fluid used proves escharotic, and productive of severe and painful eczema within about twenty-four hours after the work is commenced.

One word more concerning these skin eruptions of flax-workers. My impression is that there is an eruption due to the oils used, and a distinct eruption caused by the flax-water; the former seen chiefly among the 'doffers,' who are in constant contact with the oils, but not with the water. Besides, the eruption they are plagued with has no such precise limits in distribution as Dr. Lefebvre represents, but is diffused over hands and arms, where the skin is uncovered.

In the case of adult female flax-workers, their most common ailments are, dyspepsia, anæmia, constipation, œdema of legs with varicose veins and ulcers, and chronic forms of eczema. The wetting of their feet and clothes is also a cause of rheumatic sufferings.

Statistics of the Flax Manufacture.—Dr. Purdon, in his admirable Memoir, written in 1875, on the sanitary aspects of this occupation, produced an elaborate series of tables of the mortality of flax-workers at different ages and in the various departments of the business; but I hesitate to reproduce them, as considerable changes have since that date been wrought in the operations performed, and in the

sanitary state of the mills. With reference to Dr. Ogle's statistics, these refer solely to England and Wales; and as the linen manufacture is essentially an Irish industry, they afford a very imperfect notion of its comparative mortality. And what renders them still less available for the purpose is that he has grouped cotton- and linen-workers together. However, we may state that his calculated comparative mortality for the two trades united is a high one, namely 1088.

Jute Manufacture.—The principal seat of this manufacture is in Dundee and Arbroath. In general principle the processes resemble those in use in making linen; but as the fibres of jute are coarser, longer, and more brittle than those of flax, slight differences exist in the mechanical operations. Heckling is, of recent years, not employed, but the jute is at once sent to the carding-machine. But what would be a most dusty and injurious operation is rendered comparatively harmless by the previous profuse sprinkling of the jute with water and train-oil, for the purpose of rendering the fibres more flexible. This preparatory moistening and softening of the material is an advantage in the subsequent operations of preparing and spinning, by reducing greatly the amount of dust that this harsh substance would otherwise give off. Nevertheless I have seen jute in the course of spinning give off much coarse dust, and should anticipate that could the statistics of the jute manufacture be got at, they would, on the whole, exhibit still more insanitary results than do those of the linen trade.

It has been observed (*Factory Report*, 1890) that of all textile operatives none occupy so low a social position as those in the jute factories in Dundee. 'The work in a jute factory is dirty and disagreeable, compared either with a cotton or a woollen factory' (pp. 10, 11).

Hemp is an important material in the manufacture of carpets, and also of cordage of all sorts. As with jute, the heckling-machine is not used. In carpet-making, 'the hemp is cut into lengths of about a foot, dressed with oil, stacked for four or five days, and then passed through the "breaker-card," which scutches, cards, and arranges it in a sliver.

The coarser fibres and woody matter are extracted, and the rest are converted into tow. The slivers are made up into large bales, which are again passed through the "finishing-card," by which fresh tow is separated. These processes are dusty, the chief dust coming from the emptying of the tow-boxes. Only adults are employed in them' (*Report*, Bridges and Holmes, p. 23). Hemp as received from abroad is very dirty, and yields a large quantity of dust in the process of dressing. There is something in the quality and source of hemp that modifies its influence upon those using it. This is pointed out by Dr. Richardson (*Lect.* ii. p. 131), who states that the dust from dressing it produces severe bronchial irritation, painful expectoration, and strangling cough. 'Russian and Polish hemp both produce these effects. Neapolitan hemp does the same and something more; its dust contains a peculiar odorous substance, the dust of some vegetable or grass, the inhalation of which causes shortness of breath, constriction of the throat, and spasmodic cough in recurring paroxysms which continue for many hours after the inhalation ceases.' On experimenting with it himself, Dr. Richardson immediately felt the symptoms described, and which, as he justly remarks, are the same as those of hay-fever, a disorder ascertained to be due to the pollen of certain grasses. He however failed to detect the offending material by the microscope; but he found that the process of dressing did not eradicate it, for it produced its effects on those working it in the spinning-room.

From what has already been said about flax, and the influence of its dust on the respiratory organs, we are prepared to expect similar nervous and paroxysmal troubles in the case of hemp and jute, and to regard as unnecessary an hypothesis of a pollen or other extrinsic dust to account for the asthma; the cause of which may be attributed to an inherent quality of the flax, hemp, or jute.

Rope-making.—The manufacture of rope and other cordage, formerly carried on after a primitive fashion in 'rope-walks,' to be found in every town, has become greatly transformed by the introduction of machinery. The great rope-making establishment at Belfast has almost annihilated

every rope-walk in Ireland, and seems in a fair way of doing the same thing for England.

The hemp,—Russian or Manila, is worked on the same general lines as flax. It has first to be sorted and picked over by girls, hand-roughed and heckled, then carded and a sliver formed, which, after a certain degree of twisting in the roving-frames, is submitted to the spinning-machines. Both the wet and dry processes are used, the former principally for the fine yarn. The spun yarn is next taken to large tanks of boiling tar, through which it is slowly passed; this done, the superfluous tar is pressed out between iron rollers, and the yarn afterwards slowly dried. The next business is the twisting of the yarn into strands, on the old rope-walk principle, but by the aid of machines.

Cord made from harsh fibres has to undergo a scouring process, prior to sizing and polishing, to fit it for market.

This outline of the processes conveys the general hygienic features of rope-making, and at two points at least, viz., in the sorting and the heckling and preparing rooms, the evil of dust arises just as in working flax for linen, in no small degree, with its inevitable consequences to the respiratory organs.

Cocoa-Nut Fibre is now largely used in making mats, covering for floors, and many smaller articles. Its coarseness and comparative brittleness cannot fail to cause considerable dust in the several manufacturing operations to which they are subjected; but of its consequences to health we have as yet no record; though, *a priori*, we should conceive them to bear a general resemblance to those from jute and hemp, but, in all likelihood, without exerting the special influence of the latter upon the nerves of respiration.

Fustian Cutting is an industry connected with both the silk and the cotton trades, and as its operations are easily learnt, it attracts a miscellaneous body of workers, and affords slender remuneration. Hence it is often taken to, especially in textile districts, temporarily when trade is slack, and given up when it revives. These circumstances of employment favour perpetual changes among the workers, and, in a

proportionate degree, affect the results of statistics. Moreover, the trade is a very fluctuating one, and, for the last few years, has not been prosperous. It is an employment chiefly in the hands of females, from the age of thirteen and upwards; but both males and females are to be found at work in the same shops.

The cloth woven for fustian is first dressed on the back with flour-paste to 'stiffen' it, and thereby better resist the pressure of the knife; it is next stretched on a frame and dressed with slacked lime in a liquid form. The knife is very long, tapering to a thin sharp point, which is placed within a metal sheath or guide. The operator then skilfully inserts the point under a thread of the weft at one end, and carries it swiftly along to the other. In doing this, the trunk is advanced forward and bent somewhat to the right side.

The process, when completed, produces a velvet or velveteen pile in lines, or, in a word, the fustian.

The sanitary objections to the trade are found in the excessive walking to and fro the length of the frames for the whole working day; in the inclination of the body forward, and with one shoulder elevated above the other; in the dust thrown off from the fabric cut—a mixture of lime, flour-dust, and fluff; in the quantity of gas consumed in the workroom, and in the frequent want of sufficient cubic area and of efficient ventilation.

At the date of the inquiry by the Children's Employment Commission the ill effects of these insanitary conditions were more serious than those now experienced, by reason of irregular and prolonged hours of work, and by the employment of young children, some under the age of thirteen, and who, by their small stature, were quite unfit to carry on the work.

'Many that are put to it young,' said a witness examined, *op. cit. First Report*, p. 165, 'get their knees turned in and their shoulders out—the left side up.' And Dr. Henry Simpson of Lymm described the cutters as of inferior physical development and stamina, with the prevailing deformity—the distortion inward of the right knee, and the bulging out of the right shoulder, consequent on constant effort required in advancing the knife and keeping the arm steady.

Also, according to Mr. M'Kershaw of Royton, the ankle-joint suffers like the knee from the unequal strain. Occasionally the hip-joint is involved, and the spine gets curved. The several distortions mentioned befell children workers pretty exclusively; and the entire effects of the occupation contributed to stunt growth, deteriorate physical development, and cause pallor and debility. Mr. M'Kershaw likewise entertained the belief that puberty was delayed by early employment.

The production of dust by fustian-cutting has been noted; but the previous process, called carding, is answerable for still more; and no question exists that the mixed dust of lime, paste, and flue, is a cause of bronchitis, and, eventually, of asthmatic breathing.

The evils of fustian-cutting were greatly aggravated by accidental circumstances,—irregularity of work, dissipation alternating with semi-starvation, neglected homes, and ignorance or neglect of all sanitary laws.

Flour-Mills have had a bad reputation so far as the health of millers is concerned; and the most dismal accounts of their attendant evils are to be read in old and in foreign writers on industrial diseases. It would serve no useful purpose to repeat those accounts, especially as our endeavour is primarily to represent the present hygiene of trades in our land, and as the milling business has, within comparatively few years, been transformed by the introduction of steel-rollers in the place of the old mill-stones, and of marvellously contrived automatic machines, scarcely requiring the interposition of human hands from the beginning to the termination of the whole process of making flour. By these machines the separation of the bran, the 'germs,' and the semolina is effected, and necessary siftings are carried on in enclosed box-like constructions, whereby the escape of dust into the surrounding air is obviated. Nevertheless, as the miller requires from time to time to withdraw samples for testing, and to remove special products, one section or other has to be opened, with the emission of a slight quantity of the pulverised corn. Hence, although a modern corn-mill contrasts strongly with one of olden time, it does not entirely cease to be a dust-

producer, and the flour makes itself visible on the clothes of the millers, as well as on surrounding objects. After the lapse of years it also produces shortness of breath, with cough and expectoration. Happily the grains of flour are readily miscible with fluid, and therefore are, to a very great extent, arrested in their passage into the lungs themselves by the fluids of the mouth and nasal openings with which they get mixed, in the form of semi-fluid pasty matter, and thereupon excite efforts, and usually successful ones, to remove them. In the same manner, should they reach the bronchial tubes, their miscibility with the secretions prepares the way for their expectoration.

However, we can well understand that exposure to flour dust for lengthened periods will end in some accumulations in the form of tenacious plugs, provocative of severe paroxysmal efforts to dislodge them by coughing; and, such efforts failing, remain to block tubes, with the result of causing, on the one hand, collapse of a small area or atalectasis; and, on the other, of emphysematous dilatation of an adjoining area, by reason of increased work and pressure upon its air-cells.

There is undoubtedly but very slight irritation induced by grains of flour; nevertheless these cannot fail, as foreign material, to exercise some excitation, sufficient, possibly, to set up after a while sub-inflammatory action. In old mills, the men had to contend not only with grains of flour but also with the far more irritating particles of bran and of hair or bristles attaching to the corn, thrown off in the sifting operations; and by the action of which the lung parenchyma and air-tubes were more seriously affected. Necessarily the proportion of these hard epidermic particles differed according as oats, barley, rye, or wheat was ground. It would appear that the worst asthmatic attacks are due to the dust of oats. Where men have been exposed to the inhalation of the coarser fragments derived from the epidermic appendages of corn the sputum has borne witness to their presence.

The siliceous dust from the wear of the millstones was another injurious element that formerly intermingled with the flour, but has ceased to exist by reason of the adoption of steel-rollers for grinding corn, and it seems unlikely that it could ever be one of importance. It

is mentioned by German writers; and it is conceivable that, under the conditions of labour found in the floating mills on the Rhine and other rivers, where corn-grinding goes on perpetually in very confined spaces, and where the miller resides within the same building, the circumstance spoken of may happen. Moreover, in such places of labour there is exposure to wet and leakage, and to wind and weather—all conditions favourable to the development of chest affections. Hirt appends yet another—viz., disturbed sleep, from the necessity of watching the working of the mill.

So recently as 1884, Factory Inspector Major Beadon, who interested himself in the question (see *Factory Report* for that year), says 'it is quite exceptional to see a person who has worked any time in a flour mill who is not more or less affected as to the respiratory organs; and, contrary to the rule in most trades, the majority readily admit and deplore the fact. That the average of life among them is very low is an established fact;' and he proceeds to quote from a trade periodical, called *The Miller*, the assertion that the average life of millers is only forty-three years.

This statement, we believe, judging from our own inspection of mills erected and fitted on the most approved system, will not apply at the present time; so great have been the impro ements made in all the details of the occupation.

Hirt compiled a table of the comparative sickness and its chief causes, of bakers and millers respectively. According to this, of one hundred bakers, 7 per cent. had phthisis, whereas millers had 10 per cent. Emphysema was virtually alike in the two callings, and bronchial catarrh nearly so; but in the case of pneumonia the mortality figure for bakers was only 8·4, whilst that for millers was 42 per cent. This extraordinary difference in the matter of pneumonia in the two trades is not readily explicable. Perhaps a partial explanation may be discovered in the greater exposure of German millers to wind and moisture, and to chills night and day, owing to the residence of so many of them in floating mills. As before remarked, these foreign statistics cannot be received as accurate for the like occupations carried on in England. In fact, the statistics quoted are not supported by Dr. Ogle's calculations; for, according to these, the comparative mortality figure

in the two occupations is almost identical—namely, 958 for bakers and confectioners, and 957 for millers.

It is quite conceivable that the frequent handling of fine flour and of bran may affect the skin of the hands, and superficially irritate it; and also that particles may collect about the openings of the sudoriparous glands and of the follicles and obstruct them. This being so, we are not surprised to hear of the occurrence on the exposed parts of the epidermis in bakers and millers, of skin diseases, among which are numbered, by authors, erythema, prurigo, acne, eczema, boils, and a form of itch attributed to acari developed in meal. This last is the same as the bakers' itch heretofore noticed. But if contact with meal will generate these ills, we may feel pretty sure they will disappear when thorough cleanliness is observed. In fact, among English millers these skin eruptions are very uncommon; and, where present, are clearly the consequences of neglect of washing. Layet tells us also of irritation of the eyes by flour, and of conjunctivitis and blepharitis—casualties not probable in well-built and ventilated mills.

Remembering that a modern mill is usually four or five storeys high, and each floor well-nigh filled with machinery, it is evidently a place of danger, and too frequently of accidents in connection with the shafts, belting, and wheels, though to a less extent than formerly. Moreover, flour mills are hazardous owing to their liability to fire and explosions; originating in the extremely fine dust diffused through the atmosphere, which, if accumulated above a certain measure, explodes on contact with flame; just as happens with fine coal dust in mines. Many explosions have occurred in this country, wrecking the mills and destroying life. To obviate this disaster, care is usually taken to enclose the flames of gas-lights as far as practicable; whilst in other establishments electricity is introduced as the illuminating agent. But here, as happens with so many evils, prevention by thorough ventilation is the best cure.

A recognised source of explosion from heat, other than the flame of an illuminant, is encountered in the striking of sparks by fragments of metal caught between revolving wheels.

This source of danger, as well as of damage to machinery, is provided against by the employment of magnets attached to one section of the milling apparatus, whilst the corn is still in a coarsely powdered state. This safeguard is rendered needful, owing to the introduction of nails and fragments of iron, along with earthy matters, in corn imported for the most part from India, for the base purpose of giving weight to it. And although the greatest part of such foreign matters is removed by the preliminary washing and drying of the corn as received, yet more or fewer are apt to escape those operations undetected.

Layet speaks of the process of dressing the millstones in his notice of the occupation of millers. Where this practice prevails an additional explanation of the greater ratio of deaths from chest diseases among millers than among bakers is found.

Starch-making.—Knowing the extent of the starch-works of Messrs. Colman of Norwich, I applied to them for what particulars they could supply respecting the health and the prevalent diseases of their employés. They most courteously acceded to my request; but all the information they could give me was of a negative character. Their wide experience and observation pointed to no injurious results of the labour performed; and Dr. Fielding, the medical officer attached to the works, concurred with them. Indeed, the starch-makers are, it appears, even more healthy than the workers in other departments of the factory, judging from the fact that the claims of those workmen upon the 'Sick Fund' are proportionately smaller than those of others. There is, however, this much to be borne in mind, that exposure to wet is a more conspicuous incident, as a possible cause of illness, than that to flour dust, in the business of starch-making. For vast quantities of water are necessitated, with unavoidable exposure to wetting of clothes and feet; and, as a necessary accompaniment, a more or less humid state of the air. Every precaution is taken against these risks, by special coverings and thick wooden shoes; and no evidence is forthcoming that the starch-workers are more liable than other folk, as might, *à priori*, be imagined, to rheumatic affections.

It will be more satisfactory to have the above impressions gathered from general observation respecting the inhalation of flour dust and the consequences of starch-making, confirmed by precise and statistical investigation; and I trust Dr. Fielding will lend himself to such inquiry.

Seed Crushing and Grinding has a general resemblance to milling of corn. The only difference in hygienic conditions that exists between the two employments is that, in grinding mustard and linseed, the oily matter contained in the seed is preventive of the dispersion of dust. In fact, no injurious incident attendant on these industries, save such as belong to the use of machinery, can be charged against them.

Malt Grinding is another similar business, giving employment to a few labourers in breweries. It is mentioned as a cause of lung disease and of 'consumption.'

Corn Threshing and Chaff Cutting may be enumerated among occupations evolving dust detrimental to the respiratory apparatus. As corn threshing is now almost universally done by machines and in the open air, its injurious consequences will be of very rare occurrence. The cutting of straw for chaff, and of hay for 'chop,' will likewise rarely induce lung troubles, except when pursued for a long period as a nearly special occupation. Possibly, indeed, the prevalence of bronchial cough and of asthmatic breathing among farm labourers and stablemen may be owing more often than suspected to their employment in those operations. For observation proves that certain common grasses act specifically in inducing asthma, and that hay and straw penetrated by some moulds or minute fungi, produce very marked irritation of the mucous membrane of the eyes, nose, and respiratory passages, and at the same time develop a measles-like eruption on the skin.

These consequences attaching to straw and hay in certain conditions deserve more attention than they have yet received. A marked example of the production of lasting asthma, with injury to the air cells, has very recently occurred to me in the case of an otherwise healthy young

farmer, who a few months previously was much occupied in removing and handling some mouldy hay. After a short lapse of time, and without antecedent symptoms of a cold on the chest, or of ordinary bronchitis, he became suddenly very short of breath. When seen by me, this condition had lasted several months; and throughout the period no symptoms of fever appeared, and no constitutional disturbance, to require confinement to bed.

Charcoal Making and Grinding are very limited occupations, especially in this country. On the Continent the inhalation of charcoal dust has arrested attention by its effects on the breathing apparatus. Lewin found its particles to penetrate into the bronchial mucous membrane, and even into the air-cells; and he described them as very frequently pointed, unlike coal dust, which is made up usually of angular atoms, having several irregular sides. The dust of charcoal is not less damaging to respiration and to lung tissue than the mineral dust of coal; some say it is more so.

Charcoal operates disastrously by its dust among steel-makers and bronze moulders and casters. Casting and moulding bronze is an art little pursued in England; but it constitutes a considerable occupation in France and Germany. It is one in which the dust of charcoal has been found very injurious to the workmen by setting up chest diseases. M. Tardieu, in 1855, made a special examination and report touching this matter, showing that the workers in bronze-casting experienced the same inconveniences as do charcoal grinders and colliers. And his express purpose was to prove that potato-starch might be substituted for charcoal with vast benefit to the workmen.

He also mentions, incidentally, in his essay, that at a previous period talc in powder had been tried in place of charcoal, but that, although a very suitable material for the process of moulding, the consequences of its inhalation to the artisans were even worse.

His description of the sufferings consequent on the inhalation of charcoal, and of the lesions caused by it, resembles, in all details, that already given concernin coal dust.

Tobacco Manufacture.—This in England, unlike other European countries, is not a Government monopoly, although under the rigid supervision of the department of Excise. The State manufactories on the Continent afford a larger field than can be met with in Great Britain for the observation of the effects of tobacco upon the health of those engaged in its manufacture. But there are very considerable tobacco manufactories in this country, such as that of Messrs. Wills, of Bristol, sufficient in extent to furnish evidence on the matter. Respecting the health phenomena attending the occupation, accounts have been very diverse; but it may be stated generally, that those attributing to it serious results are chiefly found in the older writers, though some more recent ones have given them their sanction.

The processes of tobacco-making are not numerous nor complicated, but they vary according to the particular product required, whether cigars, smoking-tobacco, or snuff. The first business is to sort the leaves, and is attended by the emanation of dust of no important physiological energy. The next is to soften them by damping with water; and when this,—a harmless proceeding,—is effected, the leaves pass into the hands of women and girls, who strip away the mid-ribs. They are then ready for making into cigars by simple handiwork. But if tobacco for smoking be wanted, the leaves are cut up by machines, and afterwards subjected to a high temperature in shallow-heated pans, whereby the fumes of the plant are largely driven off; and, unless ventilation be very efficient, they will exert more or less pernicious influence upon the men engaged in the operation. The only remaining stage is the cooling of the tobacco by spreading it out in trays disposed on frames in the cooling-room.

When snuff is wanted, another series of processes come in. For cigars and tobacco, fermentation of the plant has to be avoided; whereas for snuff-making it is an essential element. After the tobacco leaves are cut up large quantities of them are brought together into a spacious chamber, where they are allowed to remain several months, in the course of which time fermentation, accompanied by considerable elevation of temperature, proceeds. When sufficiently

advanced the fermenting material is withdrawn, dried, and ground into snuff. The emptying of the fermenting chamber is an exhausting operation, and noxious to the men employed, on account of the extremely irritant gases evolved; whilst the grinding into powder becomes exceedingly annoying where proper machinery for doing it and preventing dust is not provided.

For some snuffs a second process of fermentation is conducted by damping and packing the powdered tobacco in enclosed boxes or cases for a definite period, with the resultant development of heat and of a more desiccated or high-dried snuff.

The concluding operation is the simple one of sifting to get the necessary fineness; but though simple as a mechanical art, it produces, chiefly with those not inured to tobacco, the same series of symptoms felt by uninitiated smokers.

We are chiefly indebted for these particulars to the excellent monograph on the Tobacco Manufacture in its Health Relations by Dr. Mélier, who conducted a very complete investigation of the subject, at the instance of the Academy of Medicine of Paris, among the ten large State Factories of France, in 1846.

There is a general consensus among writers, that on first entering employment in tobacco factories, both men and women, particularly the latter, suffer more or less malaise, for a brief period, marked by nausea, headache, giddiness and faintness, palpitation or præcordial oppression, diarrhœa, and the unavoidable irritation of the ori-nasal passages and the eyes. Some add dilatation of the pupil, and M. Pointe, of the Lyons Factory, stated that an amaurotic condition supervened at times with old hands, but disappeared on their giving up their work. Dr. E. T. Ely contributed a paper on the manufacture of tobacco to the *New York Medical Journal* (vol. xxxi. p. 367, 1880), and speaks of the production of cough, of pharyngeal catarrh, dyspepsia and nervousness in a small number, and of the common occurrence of bad teeth. He likewise mentions amblyopia from the abuse of tobacco. It must, however, be noted that from the character of the account given it is difficult to distinguish the results of the manufacture

to health from those due to the abuse of tobacco; for he reports that, of the 102 men he examined in a manufactory, all of them were incessantly smoking, and carried on their labour in close, insanitary rooms, on the principle of 'piece-work,' and, as a consequence, for prolonged hours. However, Dr. Ely's general conclusion is, that employment in tobacco-making is as healthy as other occupations of a like sedentary nature, unless there exist a peculiar susceptibility. Dr. Ladreit de Lacharrière (*Annales des Maladies de l'Oreille*, 1878), says that a dryness of the fauces occurs, with congestion of the Eustachian tubes, which may extend to the ossicles; and also that the velum palati becomes paralysed.

But whatever disorders be set up by the occupation, their degree and character will depend very much upon the branch followed. The most prejudicial operations are those of drying the tobacco, of clearing the fermenting-chambers, and of unloading of the cases of snuff after its second fermentation.

Speaking of men engaged in the more unhealthy branches, Mélier says, they in course of time grow pale and ashy in complexion, and acquire a peculiar physiognomy; and as they advance in years become wasted and short of breath.

The women employed—most of them working in stripping, cigar-making, and packing—are, for the most part, healthy-looking; but it is said of them that they are subject to profuse menstruation and local congestions; due, we surmise, rather to prolonged sitting than to the tobacco. Other statements are, that growth and sexual development are retarded in the case of tobacco-workers, and that their families are very limited in number. My esteemed friend, Dr. B. W. Richardson, whose anti-tobacco developed contemporaneously with his anti-alcohol sentiments, presented, in the course of his lectures before the Society of Arts (*Journal* for January 14th, 1876), a most gloomy picture of the disasters attending the tobacco manufacture, in which he brought together all the known symptoms of tobacco poisoning, of whatever intensity, which, if as energetic as they appeared to him, should speedily cut short the career of all who entered upon the occupation. The distinct facts arrived at by Mélier concerning the ages reached by tobacco

hands, show sufficiently that the serious ills related cannot exist. Moreover, Dr. Richardson is in antagonism with other physicians in asserting that 'those workmen who are disposed to pulmonary consumption suffer readily from that disease;' for, curiously enough, it has been maintained that pulmonary consumption is rarer among tobacco workers than in the population at large. Mélier, on his part, examined into this matter, and concluded this supposed immunity not to be established.

Another statement found is, that these workmen are remarkably exempt from epidemic, infectious, and cutaneous diseases; and Mélier says, that when suffering with local rheumatism, sciatica, and neuralgia, they will lie upon heaps of tobacco and often fall to sleep cured of their pain.

Nicotine is reported to have been found in the amniotic fluid and in the urine of tobacco workers. Zenker describes two autopsies of men affected with what he termed 'tobacosis.' 'There was,' he says, 'atrophy of lungs, with peculiar yellowish brown spots from granular infiltration into alveolar tissue.' Proust denies the accuracy of this observation. Hirt experimented on rabbits and dogs, making them to breathe air filled with particles of tobacco, for months at a time. The animals remained healthy, and suffered neither loss of appetite nor bronchitis. After death the lungs were found atrophied, and stained with brownish spots, though no tobacco was infiltrated in their tissue; moreover, the atrophy did not coincide with discolouration, as Zenker represented.

The discordant reports respecting the maladies of tobacco hands it is difficult to reconcile. I consider that some writers have pictured results under a conviction of what they ought to be considering the really poisonous properties of tobacco, and from what they have seen in the case of the newly employed. I have but a limited personal acquaintance with tobacco factories, but so far as it goes it does not substantiate the serious picture drawn by some writers. Where the graver symptoms have been met with, my impression is, that it has occurred among the young, and recently employed, and, when among adults, in factories ill-built, sanitarily defective, badly regulated and dirty, and where smoking and chewing have been indulged to excess. Another point worth

mentioning is, that there is a very pronounced idiosyncracy attaching to tobacco, and that it will therefore at times happen that persons suffer excessively owing to such idiosyncracy.

The most recent notice of an English tobacco manufactory I have met with is to be found in the periodical called *Hygiène*. It is an anonymous production, and gives scarcely any insight into the characteristics of the processes with relation to health, consisting chiefly of a panegyric of Messrs. Wills' excellently built factory. The general conclusions of the writer are that the occupation is a healthy one, that those engaged in it contrast favourably with the factory hands of the North of England, and that, as many previous writers have surmised, they are less liable to infectious and contagious diseases (vol. iii. 1890, p. 160) than workers in other callings.

In the Middlesex Hospital Museum there is a specimen (No. 1290) of 'pigmented and indurated lung, from a tobacco worker,' presented by Dr. Greenhow.

Quinine Manufacture, as carried on in large factories, has certain ill effects to health charged to it. These are eczema and a transitory fever. The first to call attention to these derangements among those employed in quinine factories, was M. Chevallier, in 1852. Of the frequent production of eczema there is no question, but it has this peculiar incident, that it happens only with some people, who have a remarkable susceptibility to the substance.

Those engaged in powdering and handling quinine get an erythematous irritation of the exposed parts of the arm, attributable to the penetration of the fine, needle-like particles into the pores of the skin. But this is quite distinct from quinine eczema. The latter attacks brusquely without warning; seizing on the exposed parts of the skin, causing redness, swelling, itching, and burning smarting pain. From these parts the eruption spreads widely over the body, and by its partiality to the genital organs, is a cause of great annoyance. It is truly vesicular, and at times a patch of vesicles will run together and produce a superficial ulcer, on which a crust may form; but no elevation of temperature occurs. The preparation of sulphate of cinchonine sets up the same

symptoms as the quina salt; and their outburst is assigned to the vapour given off on evaporating the salts after the addition of the acid. But this explanation cannot apply to all cases, for among the many on record are some where the individuals did not work in the factories, but merely lived close to them, and others who were attacked simply by contact with the clothes of quinine workers. The last circumstance has been especially noticed where infants have been nursed by their mothers outside the place of work.

A remarkable case is related by Dr. Ackermann, in his graduation thesis (*Des Maladies Speciales aux ouvriers employés dans les fabriques de Sulfate de Quinine*, Paris, 1880), where a silk-spinner had to work an emerald green silk, coloured by quinine, the presence of which was perceptible to the taste, and proved by analysis. This beautiful colour was obtained by pouring saturated solution of chlorine into an aqueous solution of sulphate of quinine, and then adding ammonia in slight excess.

Another feature of the quinine rash is, its great tendency to relapse, and thereupon to appear in a severer form. It is very amenable to soothing treatment, demulcent baths and gentle purging. It particularly troubles those of fair complexion, and, Hirt says, never attacks dark-skinned persons.

The occurrence of quinine fever is still a debatable matter. The accounts of it are of German origin. The author just now cited considers that they rest upon a dubious diagnosis, arrived at by a non-professional observer engaged in the manufacture. Hirt refers to no cases.

Sub-Order II. *Organic Dust of an Animal Nature.*

This is met with in the manufacture of silk, wool, hair, feathers, horns, and hoofs, and hides or skins. The two first-named materials constitute staple textile industries of this country. Hair may also be accounted as a textile substance, as it admits of being woven into a fabric or cloth; but in this form its use is very limited, being confined mainly to covering the seats of chairs and sofas, and to making a very durable stair-carpet.

§ 1. *The Silk Manufacture*, as an industry, yields in importance only to that of cotton, of linen, or of wool. And fortunately, also, it stands lowest in the list of textile industries as a dust-producing and a health-destroying occupation. Apart from the general insanitary features surrounding all textile operations, it is devoid practically of evils originating in the quality of the material and its manipulation, excepting in one department, namely, where waste silk is worked.

Silk is received from China, India, Italy, and elsewhere in a raw state, as wound from the cocoons, and requires only simple boiling in an alkaline soapy fluid to dissolve out its gummy matter, in order to fit it for future processes;—such as winding and twisting, reeling and spinning, and finally weaving. As all these operations are accompanied by little or no dust, where the best silk is in use, and may be termed harmless in regard to health.

It is otherwise where silk waste is manufactured. This material is derived either from mills, where the best silk is employed, of which it represents, in a certain sense, the refuse; or else from certain cocoons received from abroad. These foreign cocoons differ widely in quality. Some are simply cocoons which, owing to defects, are not capable of being wound off by the usual plan. Others are so mixed with dirt, as to offer, to the uninstructed eye, no semblance of being silk at all; these, consequently, require longer treatment to unfold their true nature. It is these impure cocoons that give rise, in the preparatory stages of the manufacture, to foul smells and to dust. 'The dressing of waste silk,' wrote Mr. Redgrave (*Report*, 1872, p. 51), 'is one of the most nauseous of occupations,' but may be rendered comparatively inoffensive and harmless by proper ventilating appliances. This desirable end has been more or less fully attained in all the best modern silk-mills.

The preliminary process is that of boiling the cocoons in a mixture of soap and potash to remove the 'gum,' which is an integral element of natural silk. After this, they are placed within machines, consisting of large cylinders armed inside with rows of steel teeth. By this proceeding the cocoons are torn up, the fibres roughly separated, and a vast amount of dirt combed out as dust, which falls to the bottom

of the machine. Were it not for this combing process being conducted in enclosed machines, the dust thrown off would be both very great and very pernicious, as it formerly was when this precaution was not taken. The silk is still in an unfit state for manufacture, and has to pass through yet other operations of combing by different machines, until the original rough and dull material acquires the characteristic gloss and finely fibrous appearance of silk. Having reached this state of 'staple,' the waste silk is fitted equally with the fine sorts from China and elsewhere, for the subsequent operations of the business.

The preparatory processes, after the boiling, are conducted in what are called the 'dressing-rooms;' and it is almost solely in these rooms that dust is encountered. For although many carding-machines are enclosed, and only give vent to dust at intervals when opened for any purpose, there are horizontally acting machines not admitting of enclosure by their present construction, which do throw off fine dust traceable on surrounding objects, and perceptible as a haze in the atmosphere around.

The inferior length, fineness, and strength of the materials worked in waste silk-mills, entail other modifications of the processes applicable to high-class silk. The chief of these is that of 'gassing.' This is done over 'gassing frames;' benches of various lengths, furnished with rows of gas-jets, through which the silk fibres are rapidly drawn by machinery. By this proceeding, little irregularities or fluffy eminences along the fibre are singed off. So rapid is the movement through the gas flame, that the eye is unconscious of it, the thread appearing stationary in the flame, and yet unscorched. The revolutions of the wheels drawing it through equal 150 per minute.

This gassing business appears to be equally obnoxious to health with the dressing processes. The burnt atoms float in the air, producing the smell of combustion of animal matter to a perceptible degree, and likewise a dust, visible as a thin haze. On the frames and all surrounding objects, a very fine fluff lies about, showing how much the purity of the air is defiled.

In this department, moreover, the evils of dust to health are sorely aggravated by the high temperature prevailing,

consequent upon the vast number of gas-jets, and the products of consumed gas.

The manual work is simple, being only that of piecing broken fibres and watching the machines. Hence it is the special occupation of lads. These do not follow it for long, being drafted off to other departments ranking higher in the scale of labour. Consequently the ill effects of the dust and heat have not time to manifest themselves in a very obvious manner. Nevertheless, the boys generally look languid, pale, and thin.

Where the best silk is spun, this gassing process is little employed, except when a very superior fibre is required. The gassing frames are consequently smaller, and of different construction. In one that I saw, the gas was not burned pure, but mixed with air, on the principle of a Bunsen burner; an arrangement to be commended on all grounds; inasmuch as it lessens the quantity of gas consumed, and the deterioration of the atmospheric air by the consumption of its oxygen, and the proportion of gaseous products thrown off.

In the long gassing-room of one waste silk-mill visited, although on a very cold day, the temperature was 90°, and I was informed that, in summer, with the sun beating upon the roof over it, it would rise to 120°.

It will be understood that the ills described as attending upon certain operations of the silk manufacture differ in different factories, not by reason only of variations in the quality of the material manufactured and of the machinery employed, but also in accordance with the sanitary construction and arrangements of the mills, and above all, with the efficiency of ventilation. The 'carding' and the 'gassing' rooms call for most attention.

It may be stated, generally, that all the ills that can be charged against the manufacture of silk amount to little, and that, such as they are, they must be regarded as preventible, except, indeed, sedentary labour within more or less heated rooms.

A certain amount of asthmatic breathing and bronchitis is, after long employment, set up by the dust of the dressing department, and by that of gassing. And judging from the experience of the Macclesfield Infirmary, a considerable

number of silk workers break down as age advances with symptoms of fibroid phthisis. Unfortunately there appears to have been no medical research into the pathology of such cases, and no statistical record kept. Further, the high temperature existing in certain workrooms cannot be without effect on health. Indeed, the aspect of many of the women, their anæmia and other signs, betray the ills attending their calling. Some warehouses, like the gassing rooms, are very hot from profuse use of coal gas, without arrangements for removing the products of combustion, or the heat generated. However, we may hope to see this insanitary condition removed by the adoption of the electric light, which, besides obviating heat, has the great advantage of enabling those working with it to appreciate shades of colour.

At the period when Dr. Greenhow conducted his inquiry, the silk towns were notorious for their high rate of mortality from consumption; and, in a less degree, from respiratory maladies. Since then a vast improvement has taken place in this matter, and in the case of Leek, one of those towns of which I have very precise particulars, the mortality from consumption has fallen to about the level of towns generally.

This great advance in public health has gone along with most careful and thorough hygienic supervision and action; a circumstance that clearly indicates that the extrinsic or accidental circumstances of the silk trade had a principal share in producing the high mortality that once prevailed. New mills of very improved construction have replaced the old and insanitary ones; home work in winding and other operations has vanished, the dwellings of the artisans have been made more healthy; an ample supply of good water provided, and sewerage perfected. And to a very considerable degree the Factory Laws have aided, by forbidding the employment of very young children, by promoting measures of effective ventilation, by restricting the hours of labour, and bringing about more regular work, and, over and above, arresting the employment of children of feeble development and health, or presenting bodily deformity. In Dr. Greenhow's time deformed legs, contorted spines, and flat feet were frequent phenomena among the rising population of silk towns.

Although the working details of the manufactories, and

the mode of existence of the silk workers of Lyons differ widely from those of the silk districts of England, and put comparison for statistical purposes out of question, it will prove instructive to note some of the conclusions arrived at by Dr. Pierre Givre in his recent work (Paris, 1890), *De la Tuberculose chez les ouvriers en Soie*, based on an extended review of the experience of the Lyons hospitals, and of the circumstances of factory employment. These latter are such that it is a marvel they can be allowed to exist in a country where hygiene is dealt with as an affair of State; but this is not the place to describe them in any detail.

Turning to the statistics of mortality of the three hospitals of that city, compiled for twenty-seven years in two of those institutions, and for twelve years in the third, we find that the deaths of silk workers of both sexes from tuberculosis, compared with deaths among them from all causes, have equalled 35·6 per cent. And on contrasting male with female workers, the latter show a decidedly higher proportion, and, at the same time, die at an earlier age.

Again, taking the returns of deaths from tuberculosis in the whole population of Lyons and comparing them with those of silk hands, it comes out that the latter show a percentage of 25·1 in place of 20·2. This higher rate is brought about, in Dr. Givre's opinion, by the greater mortality of winders and of carders, compared with that of other branches of the occupation. On examination of the curves expressing the death-rates of silk workers and of the general population from tuberculosis, they are seen to be parallel at all points, and indicative, therefore, of the action of the same insanitary causes in both. In other words, they do not point to the operation of 'professional' causes in the case of silk hands. To this general inference, exception has to be made in the instance of 'carders' and others working 'waste silk,' in unwinding and carding or combing the cocoons, and the portions of silk left after other processes. For, in the case of these operatives, the inhalation of dust becomes a special source of injury to health; whilst the manipulation of the cocoons in hot water develops offensive, or literally, in the words of the author, pestilential effluvia. The sputa of those affected by the dust contain not only fibres of silk but

micro-organisms, among which, the author persuades himself, are to be found the microbes of tubercle; but his figures fail to show the characteristic bacilli. His other pathological views are, that anthracosis, by whatsoever dust set up, is an ulcerative interstitial pneumonia due to tubercle; and that emphysema is antagonistic to tubercular disease. Lastly, that when pulmonary phthisis supervenes, its course is frequently rapid.

Dr. Givre submits tables to show that the mortality from tuberculosis prevails among silk artisans in no excessive degree above that of the general population; the proportion for the former being as before seen, 25·1, and for the latter 20·2. Indeed, many occupations exceed this rate; such are those of tailors and tailoresses, of dyers, shoemakers, and members of religious orders. Laundresses and masons are on an equality with it. The preponderating influences in its development in all these employments are alike in character; to wit, excessive work, indifferent nourishment, bad air and ventilation, confinement, sedentary existence, hereditary transmission and scrofulous diathesis, alcoholism and possible contagion. In 40 per cent. of his cases he reckoned defective hygiene to be the efficient cause.

By way of a running commentary on these statistics of Dr. Givre, we must note that the conditions of life and of occupation obtaining among the silk-workers of Lyons have not their counterpart among the like workmen in England. The protective provisions of factory laws, if not wanting, are inoperative; and, consequently, excessively prolonged, and even night labour are common; wages very inadequate to the wants of life, premature employment in respect of age, most insanitary arrangements for lodging, and a wretched system of boarding out. Happily great decline of the silk industry, especially in some departments, has lessened crowding and also the number of apprentices. With these last the hygienic evils referred to told with terrible force.

Silk Embroidery, Trimming, etc.—There are several minor manufactures in which silk is the article used. Such, for instance, are silk embroidery, the making of silk trimmings, braid, buttons, tassels, and sewing-thread. The last

named is almost a speciality of Leek, where, too, the other articles specified are very largely produced.

Ribbon-making is another division of the silk business, but, like the preceding, exhibits no sanitary conditions sufficiently diverse from those already noticed to demand special consideration. In many subordinate details their affinity hygienically is rather with those of dressmaking. In the instance of embroidery the art, like so many others, has, to meet the wants of 'the million,' been transformed from the position of a handicraft to that of a mechanical process, wherein the adjustments of machinery have assumed the place of hands guided by human intelligence.

By the kindness of the late Dr. Henry Fernie of Macclesfield, statistics were given me regarding 1642 persons, treated as out-patients of the Infirmary of that town during the year 1875. Of these 922 were engaged in the silk trade. Of the 1642 about 5 per cent. were children; but, of the entire number of adults, 382 were sufferers with chest diseases—phthisis, bronchitis, asthma, and emphysema; 242 had dyspepsia; 121 were anæmic or suffered from general debility; uterine derangements, skin diseases, and cardiac affections, each numbered 50; 35 were strumous; 21 had cancer; and the like number epilepsy. The remaining cases were of a surgical character, including 55 syphilitic. In round numbers, therefore, respiratory diseases constituted nearly one-fourth of the whole amount of sickness treated. The death-rate in Macclesfield of phthisis was, in 1874, about 3 per thousand.

Silk Printing is yet another department of the trade. It is either done by hand-block printing,—for the highest class of goods,—or more frequently by rollers worked by machines something like printing presses. No peculiar troubles of the general health follow this occupation; but a local consequence of the constant pressure on the ulnar side of the left hand, from holding the heavy wooden block *in situ* whilst the block is beaten strongly by a mallet held by the right hand, in the shape of a dense horn-like thickening.

Silk Dyeing.—Associated with the silk manufacture is the trade of dyeing. My personal examination and inquiries concerning the health aspects of this occupation have been

productive pretty much of a negative result (see hereafter remarks on dyeing).

There are dyes used, especially some of the aniline series, which are irritating to the skin, and cause eczematous and erythematous eruptions. Moreover, as dyers work in shops dense with steam from the vats, and the floors of which are more or less covered with water, they are prone to rheumatism, acute and chronic—particularly the latter; and by indiscreet exposure are liable to chest colds, often advancing to inflammation of the thoracic viscera.

§ 2. *The Manufacture of Wool* is the next textile employment to be examined. Two divisions of it are recognised—the worsted and the woollen manufacture. The former is commercially the more important, producing yarn for exportation as well as weaving it into material for clothing of many kinds. The latter is chiefly occupied in producing cloth and tweeds for male attire.

In 'worsted mills' the rule is to employ pure wool, which, like cotton, passes through several preparatory stages before it reaches the spinning and weaving departments; and it is in the former principally that whatever detriment to health follows has been recognised.

In the first place, the bales have to be opened, and their contents being heaped upon large tables have to be sorted, in order to separate their different qualities. Along with more or less dirt removed with the fleeces, the wool holds a considerable quantity of greasy matter. From this last it has to be freed by careful and repeated washings in alkaline fluids, and by specially constructed machines. It has, in the next place, to be subjected to 'willying' (winnowing), 'scribbling,' and 'carding machines,' to remove every portion of dirt, and to deliver it, as in the cotton manufacture, in the form of a 'sliver' of fine fibres collected in a loose rope-like form. In the preliminary combing processes considerable dust is thrown off; but by the use of enclosed machines and of fans to withdraw it as fast as it is generated, little escapes into the apartment to annoy or to injure. We owe it to the ingenuity of modern engineers that these preliminary operations have well-nigh ceased to be unhealthy.

And it is right to remark that the dust from wool is more innocuous than that of cotton, and still more so than that of linen, being by its inherent structure and its animal nature less irritating and less foreign to living animal tissue. Moreover, when the woollen fibres reach the spinning-frames, they have to be lubricated with oil, and therefore practically cease to produce dust.

The constant contact of the skin of the workers with oil is believed by themselves to be contributory to their health; and it is an undoubted fact that these wool hands contrast most favourably in health aspects with the like class of artisans in the cotton and linen manufactures.

Other advantages attending the worsted spinning are, that it is done dry, and does not need the same degree of moist heat required in the other textile trades.

Further, in the weaving of worsted a far lower and less humid temperature is called for than in the case of cotton weaving; whilst, what is of still greater moment, clay sizing and its emitted dust have no place. And through whatever operations wool has to pass, its greater length of fibre, its flexibility and toughness facilitate its manipulation and lessen its liability to breakage, and therewith the trouble and cost of 'piecing.'

The general conclusion respecting the worsted manufacture is, that it is a healthy occupation. The artisans look less anæmic and sallow than cotton operatives, whilst their social and domestic position appears more favourable. They likewise suffer less with respiratory diseases and consumption; but the proportion in which these prevail is in some degree regulated by the quality of wool used, that from Australia and the Cape being more dusty than English, and therefore more provocative of bronchial irritation.

Dr. Greenhow could not find that chest diseases and the mortality therefrom occurred in a higher ratio among the woollen workers of Bradford than with the general population. In making these general remarks on the comparative healthiness of the woollen manufacture, the serious but very occasional outbreak of wool-sorters' anthrax is not taken

into account. The history of this terrible plague follows later on.

The Cloth, Shoddy and Mungo Manufacture.—On all sides our attention is aroused by the ingenuity displayed, in recent years, in converting to use material deemed of old to be worthless. Within the compass of the wool manufacture are at least two instances of the truth of this assertion. One such is the manufacture of cloth from discarded woollen rags, the other is the recovery of the wool from obsolete fabrics where cotton is intermixed with it.

'Shoddy' and 'mungo' supply the material for the greater part of the broad-cloths, tweeds, linseys, and other fabrics woven for male attire. The cast-off woollen clothes of past wearers are resuscitated in novel forms by the processes employed, and again perform the useful functions they served in a previous state of existence.

The first operation consists in a more careful separation of the woollen from cotton and linen rags, as received from the rag-dealers. It is one attended by the evolution of much dirty dust obnoxious to the respiratory organs, and now and then charged with animal poisons of a contagious or infectious nature. As an entirely unskilled operation, bringing small reward, sorting is undertaken by a lower class of female workers, indifferently careful of their own sanitary well-being.

The sorted rags are next torn up by a machine called a 'devil,' into small fragments. This process is necessarily a most dusty and otherwise objectionable one, but as it is done in an enclosed machine, comparatively little dust escapes into the surrounding air. The heavier particles fall to the bottom, whilst the lighter are driven by a strong blast of air, blown through the machine by a fan, along a capacious tube or conduit, and disposed of in an outside place. An occasional incident of the presence within the machine of the fine woollen dust, is a conflagration or explosion, caused by the striking of the iron teeth of the revolving cylinder against portions of stone or metal accidentally mixed among the rags, and the production of sparks sufficient to fire the dust.

A further tearing apart, scribbling, or grinding is accom-

plished by a rough carding process, whereby a disintegrated mass of finely broken up wool-fibres is obtained. After the free addition of vegetable oil to this material, it is transferred to 'willying' and roving machines, from which it emerges as a filmy sheet, which is immediately, by a semi-rotary action of the machine, converted into a 'shiver,' ready for future spinning and weaving.

The addition of the oil to the carded material has the great sanitary gain of obviating the emission of dust in the subsequent operations. Whilst in the disintegrated shape, additions of new wool and of cotton are made. The wool used for cloth-making is what is known as short wool, and is not suitable to the worsted-spinners.

After cloth is woven it passes through manifold other operations. Those first pursued are intended to remove defects in the tissue, and to fit it for dyeing and pressing. Others that follow are fulling (beating the cloth by heavy weights), dressing, raising the pile by teazles fixed in revolving frames, drying in hot chambers, shearing or cutting down the pile, and some finishing processes, such as subjecting the cloth to steam in order to remove the gloss consequent on previous pressure between steam-rollers.

The only sanitary conditions to be found in these sundry proceedings requiring notice, are the dust given off when the pile is raised in dry cloth; the elevated temperature of the drying-room, reaching as it does 130° and upwards, and the steam generated in the last operation described. Shearing is a comparatively leisurely proceeding, and the fine shavings cut off have a cohesive nature which opposes their diffusion in the form of dust. In the other departments enumerated, the work is performed by adult men, who are also few in number.

A far larger number of hands are employed in dealing with the completed material; for instance, in folding, measuring, packing, stamping, and ticketing; but these operations are of a similar character with those connected with the finishing departments of other textile trades, and are not of a manufacturing nature.

Shoddy-grinding furnishes the material for making *flock wall-paper*. Another source for it exists in the fine powdery

matter produced in the operation of shearing. The 'paper flock' is prepared by sifting this disintegrated woollen substance upon the previously sized surface.

When Dr. Greenhow wrote, the grinding of woollen rags was done in unenclosed, or badly enclosed machines, and the consequence was the loading of the surrounding atmosphere with noxious dust, injurious to the employed. The inhalation of this dust he described as productive of a febrile state known as '*shoddy fever*.' It was characterised by headache, sickness, dryness of the mouth, difficult breathing, cough, and expectoration.

My own examination of shoddy-making and its machinery has furnished no evidence of the prevalence of this disorder at the present time, and I trust that 'shoddy fever' has become, like not a few other industrial diseases, a thing of the past.

Nevertheless, this anticipation may be too hopeful, for Dr. Parsons, in his excellent monograph on the 'Flock manufacture' (presently described), speaks of '*flock fever*'—the same disorder as shoddy fever, and of precisely like origin—as very prevalent. He writes:—'Mr. Illingworth, a large manufacturer, says that he has never known any one escape it. The symptoms described are those of a severe catarrh of the bronchial passages, viz., shivering, difficulty of breathing, cough, soreness of the chest, and expectoration of mucus charged with dust. In about a week's time, if the man continues at work, a tolerance of dust is established, the symptoms subside, and do not recur so long as he keeps at the same work; but on leaving it off, the tolerance for dust is soon lost, and on returning, after absence for a week or two, the workman suffers again as at first.

'Men who can eat well are said to be comparatively little affected by the dust, but those whose appetite fails are apt to break down. Heavy drinkers, on the other hand, cannot stand the dust well, and men are said to cough much at their work if they have been drunk the night before. A cold, with catarrh of the air-passages, also causes the irritative effects of the dust to be felt. When men have got used to the dust, the work is not considered unhealthy. Among some twenty-five men constantly employed by him about the rag-

machines, Mr. Illingworth says that only one has died in the past twelve years; he was a man who drank heavily, and the dust used to punish him much. He had a bad cough, and died of inflammation of the lungs' (?).

This so-called flock fever calls for no special medical treatment, and soon passes off with domestic remedies. As to hygienic measures to obviate its occurrence, Dr. Parsons rightly insists upon measures for preventing the escape and diffusion of dust; preliminary washing and disinfection, steaming, and active removal of dust by extracting fans. When such remedial plans are adopted, the anticipation that this dust 'fever' may become a thing of the past will be realised. It is an accidental and avoidable industrial disorder.

The Wool-Recovery Process.—The great commercial value of wool is demonstrated by another ingenious process invented to recover it from mixed tissues that have fulfilled their first purpose for human requirements. The account of it first given was contained in the *Report* of the Chief Inspector of Factories for 1887, and was derived from the pen of Captain May, one of the District Inspectors of the Factory Department.

The separation of the two materials is effected by hydrochloric acid, which incinerates the cotton, and leaves the wool untouched. The rags so acted on are next placed in a 'willying' machine, which, by a rotary beating action, removes the charred particles. Dust is generated in the process; but this does not represent the whole of its evils, for these machines are liable to explosions whenever fresh rags are thrust into them. This is explained on the supposition that sparks are struck from metal buttons or other metallic substances intermixed with the rags, which ignite the finely divided particles of carbon, and produce an explosion, just as happens with very fine coal dust in mines, and with flour in corn-mills.

It is a very limited industry, solely in the hands of adult men, and liable only in a small degree to damage health.

Hosiery Manufacture.—The making of hosiery is to be reckoned as a department of the woollen manufacture, but as it presents no special health aspects, excepting for the circumstance that it is largely carried on in domestic workshops, it needs no detailed description. It was originally an occupation performed by frames or machines moved by hand; but steam power long since made inroads upon the primitive processes, and facilitated and cheapened production. It would seem that more recently the scope for manual work has revived, owing to the invention of machines for weaving stockings and other minor articles in wool, readily moved by hand power. In fact, hand-frames have all along held their ground to a considerable extent; and for these reasons, that they provided labour that could be carried on in private homes, and that the work turned out is better finished and finer than what steam-moved machinery can produce.

The health conditions of the hosiery manufacture are almost entirely those of sedentary employment. In the supplementary operations of stitching and 'seaming,' there is considerable strain of the eyesight, and injury to vision is a not uncommon result. These minor handicrafts are very extensively pursued in cottage homes by children, whose labour, in bygone years, was seriously abused in regard to its duration and the age at which it was imposed. This fact was fully established by the inquiries of the Children's Employment Commission (*First Report*, p. 264, *et seq.*). Other accidental conditions materially affecting health are, the low rate of earnings for the majority, and its consequences, in the shape of miserable and insanitary homes, in defective nourishment, in overcrowding, especially in the domestic workshops, and in those moral evils of which this state of things is the immediate parent.

Blanket and Wadding Manufactures are but subordinate branches of the wool trade, and in the absence of direct information, it may be assumed that, as the material used is the same as in the other manufactures just described, whilst what differences exist are to be looked for only in the mechanical arrangements for working it, the businesses in question will present no marked special sanitary features.

Carpet-Making is yet another business in which wool enters as the most important constituent. The other material conjoined with it is hemp, to form what may be called the foundation of the produced article. The wool used for carpet-making is of coarse and short fibre; it is formed into a yarn, which is next wound on bobbins by child-labour in readiness for the weavers' looms. Hand-loom weaving has been, for the most part, supplanted by the 'power-loom,' with the advantage of materially lessening the labour of the weavers.

The manufacture of carpets is attended with considerable dust, of a mixed character of wool and hemp, but no data are within reach to furnish information as to the extent in which it operates as a cause of disease.

Statistics.—It is universally admitted that the woollen is far more healthy than the cotton and linen manufactures. Nevertheless, a certain detrimental influence upon health may be made out. Thus Dr. Ogle calculates the comparative mortality of wool-workers at 1032; and that of cotton and linen hands (in Lancashire) at 1088; the assumed normal figure being 1000. And on turning to this physician's comparative mortality table, we find that diseases of the nervous system count for 127 in the former, and for 142 in the latter business; that respiratory maladies stand respectively in the two at 205 and 271, and phthisis at 257, compared with 272. On the other hand, diseases of the circulatory and of the digestive systems are marked by a higher ratio among woollen operatives than among cotton workers.

The more limited section of the woollen manufacture represented by hosiery displays a smaller proportion of deaths from all the causes mentioned, excepting as regards diseases of the urinary system, which stand at 42, as compared with 32 for the cotton, and 36 for the woollen manufacture. On the other hand, its total comparative mortality figure is only 717, and, therefore, very decidedly under the standard of 1000.

We must recall the fact that Dr. Ogle's statistics refer only to males; however, the general truth remains, that the woollen manufacture, comparatively healthy as it is, has some share in increasing mortality. For instance, the Children's Employment Commissioners (*op. cit. First Report*) observe

that the mortality of adult women occupied in the trade, between the age of fifteen and forty-five, is 1127, the normal rate being 866 per 100,000.

Anthrax, or Wool-Sorters' Disease.—Before quitting the subject of wool in its health relations, it behoves me to call attention to the very serious consequences that may happen in sorting some kinds of this material. Those consequences are expressed by the term 'wool-sorters' disease.' It does not seem to have aroused observation when Dr. Greenhow wrote on the woollen manufacture; although, according to Bollinger (in Ziemssen's *Encyclopædia of Medicine*) attention was attracted, if not to the same, at least to a similar malady, in the course of some observations made at the tapestry works at Montpellier, so far back as 1769. The Yorkshire workmen themselves had long known that wool-sorting, by its dust and other unhealthy, though not understood, conditions, was the most disastrous department of their occupation, causing dyspnœa, cough, and consumption.

But it was not until the introduction of alpaca, mohair, and camel-hair into the mills that the fatal symptoms characteristic of 'wool-sorters' disease' were discriminated. The occurrence of several deaths, under peculiar circumstances, led to coroners' inquiries, and these were followed up by careful medical investigations, in which Dr. Bell, of Bradford, especially distinguished himself. This physician, in the first place, found that the mortality of sorters handling the newly introduced materials was double that of those dealing only with British and Colonial wools; and that the worst fleeces came from Russian Tartary, and were especially filthy, by mixture with blood, decomposed portions of flesh, and other abominations. To the ordinary symptoms common among sorters of wool were added, increased oppression of breathing, giddiness, shivering, drowsiness, sore throat, vomiting, and terrible prostration.

Dr. Bell forthwith collected particulars of seven cases in which death occurred, but had to regret their insufficiency to supply a complete clinical history. The best-marked phenomena were—the insidious onset, the rapid course and termination in death, whilst the mind remained undisturbed.

At first there was only a feeling of malaise and weakness, little regarded by the sufferers, until the rapid advance of the symptoms led them to seek medical aid. Presently there arose usually more or less pain in the chest and back, with sense of oppression, accelerated pulse, and breathing; but, excepting in one case, with no marked rise of temperature. Sweating was not general, and rigors were uncomplained of. The chest symptoms varied from rhonchus, with dry and moist râles chiefly at the base of the lungs, to such as evidenced pleuritic effusion in one case, and marked pneumonia in another. This one pneumonic case might, possibly, as Dr. Bell observes, have been regarded an ordinary example of the malady, could the man's employment be left out of sight, together with the fact that two other men, working in the same shop, were attacked, just at the same period, with wool-sorters' disease of the usual type.

As already noted, the rapidly fatal course of the malady is remarkable. In two instances it terminated in nineteen hours from the time any illness was felt. In others it was prolonged to three or four days; and it appeared that death might ensue in the primary stage of collapse, or be postponed until the pulmonary lesions bring it about. In two of the recorded cases an autopsy was obtained. In both pleurisy was found. In one, patchy pneumonia was seen; in the other, the lungs were loaded with black blood, though still able to float on water; the cardiac cavities were filled with dark, semi-fluid blood, and the pericardium held an ounce of sanguinolent serum. The spleen, unfortunately, does not appear to have been examined in either of the two cases.

From some workmen examined at the inquests, it was elicited that they had suffered illness from handling offensive bales of wool, which lasted for weeks, and even months, marked by such symptoms as chilliness, weakness, and vomiting; partial insensibility in portions of the body, and even by incomplete paralysis of the thumb and fingers. One man lost his finger-nails; whilst another had a blister form on his forefinger, ending with the loss of its distal joint.

A kind letter from Dr. Hall informs me that the disease ranged more widely than at first supposed; that it attacked not only sorters, but likewise wool-washers, packers, carders,

combers, overlookers, buyers, and staplers; and that in one instance, the wife of a mohair sorter, who had not been within half a mile of the mill, had fatal anthrax in the face.

After death decomposition is extremely rapid, with red and purple discoloration of the neck, ears, fingers, and scrotum. Internally a gelatinous infiltration is found in the cellulur tissue beneath the sternum, and at times around the kidneys. Nearly always a large quantity of fluid accumulates in the pleura, and probably within a few hours before death. The bronchial glands are enlarged and infiltrated with blood; and bloody effusions are seen about the heart, in the mesentery and at the base of the brain; whilst small extravasations occur within every internal organ. The spleen is soft but not enlarged. The blood is always dark-coloured and fluid. No treatment has succeeded. In one case hot-air baths at 120° were tried, with the result that the patient's temperature rose to 110°, and death followed in three hours. Dr. Bell, however, believes from experiments made with this case, that the bacilli were killed by the heat. The clinical history, therefore, of wool-sorters' disease agrees in all points with that of malignant pustule or anthrax, and recent observers have discovered the form of bacillus to which its production is due.

I must refrain entering more fully into the pathology of wool-sorters' disease. It has been largely written on since Dr. Bell's early investigations were made, by many eminent medical men; and besides the paragraphs respecting anthrax occurring among rag-sorters, horse hair, and flock-makers, and dealers in hides to be found in this treatise, I may refer to the admirable review of the subject contained in the *Report of the Medical Officer of the Local Government Board for* 1880, and to a compendious account that appeared in the *Report of the Chief Inspector of Factories*, published in 1880 (p. 29 *et seq.*), which reproduces the histories of some fatal cases, the evidence of several wool-sorters, and appends a list of proposed prophylactic measures against the occurrence of this fatal malady. These last-named measures are those adopted by a committee of Bradford manufacturers. They consist in recommending that all suspicious or noxious bales

of wool or hair be in the first instance steeped in water before being opened; and that after remaining sufficiently long in water to be soaked throughout, the wool be placed in a sud of hot water and washed, then passed through rollers to express the water, and that after being partly dried, the sorting be done as early as possible. The heat of the water to be from 100 to 120°. Again, that thorough ventilation be provided for the sorting-room; the floors swept daily, the walls and ceiling swept once in three months, and thoroughly cleaned; and the walls lime-washed with lime mixed with carbolic acid, once in twelve months. The next clause required that ample space and ventilation of the store-rooms be provided; and the last one enjoined that no food be taken or eaten in sorting-rooms, and that means for washing be found for the use of the sorters in a convenient place.

I subjoin to this notice of wool-sorters' disease an account of the principal conclusions arrived at by the late Mr. John Spear concerning the form of anthrax 'occurring among persons engaged in the *London Hide and Skin Trades*, published in 1883, in the Appendix to the *Report of the Local Government Board*, particularly as Mr. Spear introduced in it some comparative memoranda between anthrax as met with amongst wool-sorters, and that observed among those handling hides and skins. These latter are of several classes, and in various degrees expose to the risk of infection. Those who handle hides most on their receipt at the docks are the labourers who work under the direction of the sorters, and after them the dock labourers, who assist in various ways. The tanners presently mentioned are those who have to handle the hides on their receipt at the tannery, and to submit them to the primary cleansing and liming in pits.

The occupations in which the cases of anthrax occurred were:—Stevedore (1), wharf manager and foreman (1), wharf labourers (9), sorters' labourers (11), merchants and buyers (1), carters (1), tanners (12—all but one being labourers engaged in the first process), unhairers of rabbit-skins (1). On the other hand, no dock labourers, bargeman, Custom-house officers, fellmongers, or persons engaged in various

other minor or subsidiary branches of the trade (glue, gelatine, felt, manure-makers, etc.) suffered; but there were two doubtful cases among sorters.

Mr. Spear compared his London experience with the records published respecting the outbreak of the wool-sorters' disease in Yorkshire some four years previously. 'The London experience (he remarked) is very different from that of Bradford. There, during the eleven months taken for exact observation, the proportion of fully-developed attacks of *internal* anthrax, or anthrax fever, to those of the external variety (although including amongst the latter two cases in which the malignant pustule seemed to follow general infection) was as 23 to 9; and in earlier years the preponderance of the former class appears to have been even greater. It is very generally opined that the clinical varieties of this disease are determined by the accident of invasion,—that in external or cutaneous and in intestinal anthrax, infection occurs by local inoculation of a "fixed" virus; in anthrax fever by the invasion of the respiratory organs by volatile particles. . . . The wool-sorters' handling of the material, which is for them the vehicle of infection, is certainly the more intimate' (*op. cit.* p. 113).

Before concluding his report, Mr. Spear discusses some hypotheses to account for the less virulence of the disease as met with in London than experienced in Yorkshire. Into these problems it is not my business to enter. The subject of anthrax again comes before us in treating of the manufacture of hair, and what will then appear might, indeed, have been produced in the present place, only that it seemed better, at the risk of some repetition, to connect the appearance of the malady with each individual occupation it has invaded. Besides, we have the fact before us, that its clinical history somewhat varies according to accidental circumstances appertaining to the material charged with the poisonous virus, and to the way the infected substance is dealt with.

§ 3. *The Hair Manufacture*, as a textile art, is of very limited extent. Hair is woven as a cloth chiefly for chair-bottoms, and, in a limited degree, for stair covering. In a clean condition it is free from injurious effects to health, and its

weaving occasions little dust. But this harmless character does not belong to it before its cleansing; in fact, hair as received from abroad, has proved disastrous to health and life.

As imported, especially from Russian Siberia, it is mixed with dirt and filth, like the wool from the Van region, and to prepare it for use, it has first to be sorted and submitted to the processes of willying, combing, and carding, in the progress of which vast quantities of offensive dust are thrown off; and experience has proved that this dust is at times laden with virulent poisonous properties.

The separation or purification by 'willying' is done in an enclosed machine to avoid the diffusion of dust. The hair is afterwards boiled and dyed, and then 'curled.' These operations are performed especially in the case of short hair. The boiling causes an offensive odour, particularly when pigs' hair is dealt with.

Dr. Greenhow found thirty hecklers in a hair factory, where 500 women and girls were employed in the several departments. Of those hecklers few were at work; but of these, five were suffering more or less from cough and shortness of breath, the effects of inhaling dust. The same evils he ascertained to be common among the sorters.

A violent outbreak of anthrax occurred several years since at some hair factories near Glasgow, and arrested the attention of the Local Government Board. At the instance of Sir John Simon, an investigation was instituted by Dr. James B. Russell, the able Medical Officer of Health of that city, who wrote an excellent account of it, published in the eighth *Report* (1878-79).

Of this document, I will quote only some of the leading facts and conclusions.

The inquiry was brought about in a similar way to that respecting wool-sorters' disease. Several deaths occurred with antecedent symptoms of remarkable features. The sufferers were chiefly females who had been engaged in sorting the hair, and what revealed the true nature of their illness was the appearance of a large and soft swelling on one side the neck, having the characteristics of anthrax. But this outward and visible sign of the malady was not in

all cases noticed, for several deaths occurred by collapse following symptoms only of constitutional disturbance. The duration of the malady was from two to four days.

The form assumed varied according to the mode of access of the contagion, whether by the mouth, or by the medium of the hair follicles, or other natural or artificial openings in the integument. When inhaled or swallowed, the result was a constitutional malady, called charbon-fever, or intestinal mycosis; but when it entered by the skin, the result was malignant pustule, charbon, or anthrax proper, with the rise and progress of which the constitutional symptoms coincided.

Anthrax, it would appear, is always more or less rife in Russian Siberia, although by no means peculiar to that region, as it prevails at times epidemically in various countries of Europe and also in America. Happily it has no continued career in Great Britain. The bacilli of anthrax have resting spores which, when once dried, seem well-nigh imperishable: whilst their minuteness favours their dispersion through the atmosphere, and their transport by materials of all sorts, particularly the hides and hair of animals, with the dirt and dust of which they become intermingled.

Descriptive details of the disease and its bacilli are here uncalled for. But it is incumbent to add that Thackrah, in 1831, noticed the ill consequences attending the employment of hair-workers, though apparently without distinguishing the peculiar features of anthrax. Likewise, early in the eighteenth century the malady attracted the attention of both French and Italian physicians; and foreign writers speak of the disease as happening among those who handle the skins, the bristles, the horns, and hoofs of infected cattle: and that in consequence fellmongers, furriers, fur-dyers, mattress-makers, and makers of coarse hats, and even tallow-melters.

The history of this hair-sorters' septic malady adds another instance to the series of like disorders traceable to the introduction of poisonous germs into the system, as exemplified in wool and rag-sorters' disease. That all originate from the same bacillus is still a problem; but if we accept the account given of the outbreak of disease among some

sorters of rags for paper-making at Riga, recorded on p. 233, the probability is that there are several forms of bacilli.

In a letter very kindly written me by Dr. Russell, it is stated that no subsequent outbreak of anthrax has happened in the hair stores and factories near Glasgow, care being taken to reject Russian samples, and to cleanse and disinfect the material before it is worked with.

The Upholsterers' occupation—is one concerned with feathers, flock, and down, and hair, each and all materials laden with dust, and almost of necessity productive of respiratory troubles, particularly in the preparatory operations of cleansing them by beating and washing.

I shall first treat of flock-making, which takes the position of a manufacture concerned in producing and preparing flock for the future use of upholsterers. The possible dissemination of infectious diseases in making rag-flock induced Sir G. Buchanan to refer the question to Dr. H. F. Parsons, one of the most able members of his staff in the Local Government Board Office, who ultimately made a special report on the trade, from which I shall largely borrow.

Whatever risk attends this business depends on the nature and antecedents of the rags, for the mechanical tearing up has of itself none. The rags are woollen, or partly cotton; often in a very dirty condition, and for the most part the refuse of shoddy-mills. But a superior kind of flock is made from new wool-combings, coming from worsted mills.

The first process is the tearing up of the rags in a grinding machine or 'devil,' but not to the like degree of fineness required for cloth-making. The machine is boxed in, and the dust drawn out by a fan. The amount of dust separated from unwashed rags may be from 25 to 50 per cent. of the weight.

There is another process for making flock from chopped-up rags placed in a sort of pulping-mill with water, and afterwards dried. In other places, the rags are first of all washed, and some disinfectant used, such as permanganate of potash or sulphurous acid, or otherwise they are subjected to highly heated steam.

Dr. Parsons' investigations as to the health effects of the occupation, resulted in the conclusion that the workpeople inhaled the dust, and suffered bronchial irritation, but that infectious diseases were not contracted by them, except in very rare instances. The transmission of contagion he held to be considerably more common in the case of people dealing with cotton and linen rags; and he accounts for this fact, because rags of the latter quality are derived much more largely from garments in immediate contact with the bodies of the sick than are woollen rags. Small-pox appears to be the malady that is most transmissible by the medium of rags, and the worst example known happened at a paper-mill where the best class of writing paper was made from white rags; and where coloured ones were set aside.

The waste of flock-making is sold for manure, and an instance is on record of the production therefrom of erysipelatous inflammation, and febrile disturbance with gastro-intestinal symptoms, diarrhœa, and sickness. In a previous page (p. 407), a description is given of the so-called 'shoddy-fever.'

Upholsterers deal with flock for stuffing beds and other articles. Happily for them, the previous cleansing of the material sufficiently destroys any infectious matters it might originally have contained; but where old flock is re-used without due disinfection, by low-class upholsterers, danger may arise.

Other materials used by upholsterers are horse and cow hair, feathers, 'mill-puff,' *i.e.* the woolly waste beaten out in the process of fulling cloth; cotton flock, the refuse of raw cotton, straw, chaff, cocoa-nut fibres, and coarse wiry grass, similar to mat-grass, and lastly, some zosteras, or sea-weed imported from Russia.

Of these substances generally, it may be stated that they are harmless, unless they have been previously used, or in some other way acquired infectious qualities. Feathers are purified by steam heat; and horse hair, besides being cleansed by washing, is curled at a very high temperature, about 300° F.

'The dust which flock contains, as received from the manufacturer, is further removed by a process of beating and carding at the hands of the upholsterer before the flock is used for stuffing' (Dr. Parsons, *op. cit.* p. 10).

To provide against the dangers of flock-making, Dr. Parsons insists on the necessity for the previous disinfection of the rags, 'preferably in the bale. The best disinfectant for the purpose is heat in the form of superheated steam, or hot moist air.' This has been experimentally shown to be preferable to sulphurous acid. The dangers of rag-sorting are further illustrated in the account of paper-making.

§ 4. *Feathers, etc.*—The cleaning and dressing of feathers is a dusty business, but few are engaged in it except at intervals; and the custom prevails to cover up the mouth and nose to escape inhalation. The dust is of a suffocating character, and soon produces shortness of breathing. Happily, feathers are purified by steam heat, and so disinfected.

The *ostrich feather* business is chiefly carried on by women and girls, who clip, sow, and twist the feathers, and scrape the quills. It is very light work and rather dusty; but no available information exists concerning its influence upon health. In so limited trades as those here spoken of, it is indeed next to impossible to obtain such information; still opportunity ought to be found for so doing in some of the great London upholstery firms where constant employment is given, and where, too, a medical man is often retained to attend in cases of sickness.

Hirt (*op. cit.* p. 236) gives a very sombre account of the health of workers among feathers. They are, he states, always weak, and the dust operates so intensely, that none escape illness after three years' employment; this illness not always manifesting itself solely in the respiratory organs, but very frequently in chronic inflammatory troubles of the eyes. Perpetual catarrhs often advance to consumption, and the fine fluffy particles accumulate in the larger bronchial tubes, and, in all probability, find their way into the smaller ones; but to what extent, and with what intimate resultant changes, autopsies are wanted to demonstrate. The dust appears as a conglomerate of particles, many of them branching, and can be detected in the sputa.

Ivory, Bone, Horn, and Tortoise-Shell are largely used in the making of numerous ornamental and useful articles,

and in the processes of sawing, turning, and polishing develop considerable dust. According to Hirt, dusts of animal origin are more prejudicial to health than those derived from the vegetable world; and that where the latter produce 11 to 13 per cent. of the mortality of sick people, the former cause 20 per cent. We have no means of testing the accuracy of these comparative figures, but must feel some scepticism regarding them. As to the dust of mother-of-pearl, and, in a lesser degree, that of fossil ivory, we are quite ready to admit their position among the more destructive varieties of dust. But with regard to bone, tortoise-shell, and horn, there is no evidence that the dust generated by their employment is of like serious moment to health. In fact, looking to what experience teaches regarding horn, we are justified in the belief that substances of a gelatinous nature are but slightly obnoxious to the lungs.

Those engaged in making combs and other small articles from such substances, are admittedly very free from ill consequences, and look well nourished. The latter fact is attributed by themselves to the abundant gelatinous dust in which they work. But without going so far as to allow a nutritious value to that material, a hypothesis may be hazarded to account for its feeble influence for evil to the respiratory organs, viz., that the finely powdered horn tissue may undergo dissolution in the warm secretion of the mucous membrane, and undergo absorption, just as happens with catgut ligatures left within a cavity of the body (see also p. 219).

That there cannot be complete immunity in the case of horn dust, is what probability suggests, and as, indeed, Dr. Greenhow's observation of impeded breathing in old hands indicated (*Third Report*, p. 125).

It is a reasonable assumption that there is direct connection between the harmlessness of an animal dust and the proportionate amount of gelatine it contains. Hence, when bone-dust is compared with that of gelatine, we are prepared to expect the former to be more irritant to lung tissue, by reason of the presence in it of a considerable modicum of mineral matter in the shape of phosphate of lime; and such experience proves to be the case. For the makers of bone and ivory buttons, and other articles in the same materials,

are known to suffer cough and shortness of breath after following their trade for a number of years.

In the *Factory Report* for 1887, Captain Smith, the Inspector at Sheffield, tells us that the men employed in table-knife 'hafting,' who round off the bone hafts, or reduce them by means of a 'glazer,' set free such clouds of dust that, 'in a short time it is impossible to see across the workshop. This bone-dust is admitted to be very injurious' (p. 38). Formerly no attempt was made to get rid of it, but now the adoption of fans to withdraw it is enforced.

GROUP II.

OCCUPATIONS INJURIOUS TO HEALTH BY THE EMPLOYMENT OR PRODUCTION OF MATERIALS OF A DISTINCTLY POISONOUS OR NOXIOUS NATURE.

Materials used or prepared in manufacture of a distinctly Poisonous or Noxious quality.—The materials in view are solids, and either of a metallic or non-metallic constitution. The more important metallic forms are lead, mercury, copper, and arsenic; the non-metallic are phosphorus, sulphur, chromium, chlorine, and carbon. There are many derivatives of these substances of importance in the industrial arts, such as the chromates, chloride of lime, and sulphide of carbon.

Zinc and tin likewise have a place in the list on account of the poisonous properties of some of their salts used in trade. But it is impossible to introduce all the salts of metallic and non-metallic bodies, of a pernicious character found in trades, for an attempt to do so would involve writing a treatise on the chemical technology of poisons.

SECTION I. *Lead.*—This metal may fitly take the first place in this chapter on poisonous substances employed in the arts, by reason of its many combinations and of their extensive application. Indeed, compounds of this metal meet us at every turn, and often in places and objects where we might least expect them; and ample material could be found in

their examination, from a sanitary point of view, to form a volume. An exhaustive account cannot, therefore, be attempted in these pages.

Its effects on the human economy are well known under the name of plumbism; and, in brief, may be described as colic, constipation, dyspepsia, arthralgia, paralysis of very varying extent, loss of sight, atrophy of muscles, general emaciation, anæmia, and often epileptic convulsions, encephalopathy, and renal disease, shown by albuminuria. An almost unerring indication of its presence in the system exists in the appearance of a blue line along the junction of the gums with the teeth, and sometimes of a diffused discoloration of the hard palate.

I make no attempt to examine the mode of action of the metal upon the human system, or to discuss the various lesions or disorders found in company with it, as to do so would involve me in a long medical disquisition, suitable in a treatise on medicine, but not in a sketch of industrial maladies.

In making an examination of the hygienic relations of lead, it will be the best plan to first treat of metallic lead and its manufacture, and afterwards of its alloys and compounds (see also on Lead Mining, p. 290).

A. *Metallic Lead.*—The operations of mining and smelting of lead ores in relation to the health of those employed are elsewhere described in the chapters on noxious dusts and vapours. But when the metal leaves the hands of the smelters in the shape of 'pigs,' it has to pass through various processes to fit for future purposes of manufacture and trade. The early operations are casting into sheets and rolling. Another one is that of making lead pipes, formerly done by rolling sheet lead into a tubular form and sealing the edges, but now by a powerful machine which drives a column of molten metal, by hydrostatic pressure, around a core, and thus forms a pipe without any line of junction.

Experience has proved that exposure to the vapour of metallic lead in a fused state is sufficient to cause plumbism. Hence it happens that several classes of workpeople become sufferers with it—such are smelters, and the operatives who melt lead to make alloys, or who run the metal into moulds.

This last work is seen in white and red lead works, in making lead castings of various sizes and patterns; in the manufacture of shot, in stereotyping and typefounding, and in producing leaden toys.

Plumbers, also, are now and then affected by the fumes of solder, of which lead is a principal ingredient, as well as by handling the metal itself, a circumstance prominent among plumbers constantly employed on oil-of-vitriol works in repairing the chambers, pipes, etc.

The fumes of metallic lead in a molten state as a cause of plumbism, have not been sufficiently noted. No better evidence of the copiousness of those fumes can be afforded than that furnished by smelting works. In these places, whether the lead ore be smelted on the old-fashioned hearth, or in a reverbatory furnace, such is the quantity of lead evolved that long conduits, a mile or two in length, are constructed to intercept the vapours and to allow of their condensation in their passage to the outlet ending usually in a high chimney.

These long channels or flues are cleaned out several times in the course of a year, when not only is a profitable quantity of arsenious acid removed, but also a highly remunerative proportion of lead and silver,—the latter an almost constant component of lead ore.

Other examples of lead-poisoning by contact with the metal are to be met with among those engaged in rolling sheet lead, in making lead pipes, in making and handling letterpress type, and in file-making.

The men engaged in the last business are very frequent sufferers, although the contact of the skin with the metal is of very limited extent. Indeed, this circumstance alone does not seem adequate to account for the result, and we are induced to attribute it in part to the inhalation of the dust raised by the attrition of the chisel, and the constant blows upon the lead 'bed' (see p. 339).

Instances, too, of plumbism by contact are occasionally furnished from among the artisans who work Jacquard looms, and have frequently to handle the attached leaden weights; and also among workmen employed in lining boxes, or covering

articles with lead foil. But this much has to be remembered in discussing the production of plumbism by handling metallic lead, that the workmen are too frequently very negligent of cleanliness. They are apt to neglect the cleansing of their working clothes, and to wear them when away from their shops. They will also carry food and eat it in their shops with unwashen hands, and in these ways introduce the poison into the alimentary canal as well as into the air-passages.

A curious example of poisoning by metallic lead is on record, where, in a flour mill abroad, the small leaden buckets working on an endless chain poisoned the flour in passing over them. Lead combs have also been known to give rise to the injurious effects of the metal in its natural state; but probably rendered more active by the presence of grease.

There are numerous alloys of lead with tin, zinc, and other metals, which must be looked upon suspiciously as possible sources of plumbism, when articles of food come into contact with them. This fact has been exemplified in the case of preserved fruits and animal substances enclosed in boxes made of alloys and sealed by solder. Pewter, Dutch and Britannia-metal vessels are accused of causing lead-poisoning, where fluids have been allowed to remain in contact with them for a long period. Enamelled cooking utensils cause the like result where the enamel contains lead. Even the composition capsules covering the necks of bottles are stated to do the same thing; and where bottles have been cleaned by lead shot and not thoroughly cleansed from them, the like evil has arisen. In most or all such instances, the contained fluids or solids have co-operated by inducing chemical action. The solubility of lead in pure water contained in leaden cisterns and pipes needs only to be mentioned.

In certain cases the presence of lead in combination with other metals must be deemed an adulterant, as, for instance, in brass and in tin, where it adds to quantity at the cost of quality, and with the risk of danger to the public health.

As glazes for earthenware and china, and sometimes for stoneware are lead compounds, it is evident that any material brought into contact with them possessing a solvent power will set free the poisonous substance and endanger health. For the so-called Rockingham ware a very soft glaze is employed,

and this therefore is more readily decomposed and detached. Again, instances are recorded of poisoning where pickled or salted meat has long lain in common earthenware glazed vessels.

B. *Salts of Lead* enter into the processes of a multitude of manufactures. Several are used as dyeing and colouring materials in the textile and other trades, in making glazes and enamels, and as a necessary component of colours employed in glass-making and pottery. It is an ingredient in the enamel of visiting and other cards, of sticks, patent leather boots and the lining of hats, and of rainproof glossy caps and capes and aprons. Fortunately, invention and skill have succeeded in producing hard enamels devoid of lead for lining kitchen utensils, covering advertisement plates and other useful purposes.

Red lead, in the shape of massicot, litharge and minium, is widely employed. It has been used to colour wafers; it enters into the composition of glass, of artificial precious stones, and of putty, and is used as a polishing powder by lapidaries, and also enters as a component of glass itself. It is a necessary adjunct to the art of vulcanising and to the construction of electric accumulators.

White lead is the basis of paint, and is sprinkled on lace to throw up the pattern. Other reprehensible uses are found for lead salts, in making cosmetics and violet powder, in adulterating snuff, in colouring the cord-like fuse seen in tobacconists' shops, and in weighting sewing silk; and some people have gone so far as to use the yellow chromate to colour confectionery as a substitute for turmeric and saffron. Lastly, the brightly-coloured chromates are employed to colour artificial flowers and fruit, soap, wafers, and sealing-wax, and in the composition of colours for ornamenting pottery.

C.—*The Manufacture of White and Red Lead* is carried on in factories of considerable magnitude in many parts of the kingdom. The chemistry of the process it is not our business to discuss. The first operation is to melt the lead in an open caldron; around this several men stand and ladle the liquid metal into simple moulds, from which it turns out in thin, square-shaped, trellis-like plates, so formed

in order to favour the chemical action that follows. This takes place in earthenware jars or pots packed in tan in tiers, and disposed in large chambers or 'stacks,' to which air has free access. A certain quantity of acetic acid is added to each vessel. This done, the mouth of it is lightly covered. Heat is generated by chemical action, carbonic acid freely evolved; and the acetate of the metal, at first formed, becomes converted into the carbonate, the whole operation extending over an average period of about three months.

The transformation into carbonate being completed, the next business is to remove and empty the pots. For this purpose the 'stack' has to be entered, the boards separating the several tiers removed, and the jars taken out from the surrounding tan, and carried off in trays to the crusher and grinding machine. The emptying of the stack is rightly the work of men; but women will take part in it in order to clear the stack the sooner, for to do so brings more gain,—the work being piecework.

It is usually the business of women to fill the pots with the 'blue' (*i.e.* metallic) lead, and to carry those vessels into the 'stack' for the conversion process. The prevailing custom among them is to carry the trays upon their heads, a practice that favours, when the jars contain the converted metal,—the carbonate, a scattering of the dust over their clothes.

The evolution of dust at the crusher is abated by turning a spray of water upon the mass. Its subsequent grinding is done wet. The whole of the metallic lead is seldom wholly converted in the jars into the carbonate, and consequently when the mass operated upon reaches the mill, the unfinished portions have to be picked out before grinding can be proceeded with.

The finely-ground lead falls into a tank of water, where it is well stirred. After several similar washings, the deposited powder is ladled out and conveyed to the 'stove' or drying-room, an ordinary apartment fitted on all sides with shelves. The prepared lead is carried in jars by women, who deposit them on shelves, in doing which they have much climbing by means of rough staging. This task seems an unfitting one for women, as it risks the falling of the material upon them and unfeminine clambering.

The *Red-lead* manufacture is less destructive of health. It is made by subjecting the metal in pans to gradual oxidation in a reverbatory furnace to which air is admitted. To facilitate oxidation the molten metal is kept constantly stirred by long iron rods, worked by men, who watch at the same time the changes of colour that ensue, and which represent different stages of oxidation. To prevent too close contiguity to the open mouth of the furnace, the iron stirring rod is some ten feet in length, and proportionately strong; and, as a consequence, too heavy to be worked by the unassisted hands; hence it is suspended at about one-third of its length from the furnace mouth, and in such a manner as to be passed freely over the surface of the oxidising metal. Nevertheless, the labour of the work is very heavy, and only vigorous men are suited for it.

After one heating it is transferred to one or more furnaces heated to different degrees, according to the colour of the oxide required—for various tints are in requisition for its various industrial applications. After being withdrawn from the furnace the red lead is ground by a machine, from which it falls into tanks filled with water, and there worked with long paddles into a thick paste to be removed after subsidence, then dried, and ultimately finely ground. Casking is the next business, and one in which a great deal of dust is emitted. Happily this department gives employment to only two or three men in a factory. The men engaged at stirring the roasting metal are said to rarely suffer from their calling. On reviewing the above described processes of white and red lead making, those especially charged with ill consequences are: the clearing out of the stacks and the carriage of the carbonate to the crushing-mill, and still more, the subsequent filling and clearing of the drying stoves. This last is recognised always as the most unhealthy occupation in lead works. In our preliminary remarks on lead, we have stated that the vapour of molten lead will produce plumbism; and numerous proofs have been offered of the truth of the statement. But those concerned in lead factories are unwilling to admit it. The same agnosticism is extended to the ills asserted to follow contact with metallic lead in the operations of rolling, of lead pipe making, and of casting.

But the incredulity cannot be maintained respecting the production of plumbism when the dust of the carbonate, and in a less degree that of the red oxide, obtain access to the system.

Numerous plans for manufacturing white and red lead, intended to do away with those ordinarily pursued, have been proposed and patented; but, up to the present time, not one of them has gained general approval. White lead has, indeed, been produced, but those whose business it has been to apply it to practical purposes have been dissatisfied with the quality, especially where it has to be mixed to form paint. Quite recently new schemes have been brought forward promising the cheap production of the much-desired qualities. The 'MacIvor Ammonia process' is one such, and another is the formation of the carbonate by electrolysis, direct from the lead, by the operation of nascent carbonic acid, made effective by electrical force. It is to be hoped that, in the interests of humanity, success will wait on one or both of these inventions. Until, however, the ingenuity of inventors, working with the special object of mitigating or removing the sad consequences connected with the manufacture of the lead salts of commerce, has devised a remedy, it is incumbent on all manufacturers and workpeople to use whatever prophylactic and preventive measures science and experience have suggested. To secure these ends, special factory regulations have been made by the authority of the Secretary of State for the Home Department, upon the advice of the Factory Inspectors. As yet they have not proved to be far-reaching enough to prevent an enormous amount of lead-poisoning in the trades of the country. Their guiding principle has been to enforce cleanliness, to forbid the taking and eating of food in workrooms where lead is being made or used, and to secure ventilation. Additional measures have been taken by some manufacturers who, besides providing lavatories and baths, supply capacious blouses or overalls to cover the whole body—for women, in lead works, petticoats and trousers, and for men, linen jackets, leggings and aprons—to replace the ordinary articles of dress which are, previously to working, removed and kept in a special apartment. Sometimes gloves are supplied, and also respirators, whilst the head is covered by a suitable cap,

and fluffy, loose woollen neckerchiefs interdicted. Another accessory means is to place at discretion an ample supply of a drink acidulated with sulphuric acid, or else of milk, as some prefer.

But ignorance, prejudice, and obstinacy mar the success of the best-intentioned efforts; and too frequently, where the manufacturer has made the best arrangements in the interests of health, these are rendered nugatory, or greatly lessened in efficiency by his workpeople. The wearing of respirators is a constant bone of contention, and is often set at naught. The specially adapted dresses are tossed aside because they hide the charms of the wearers, or for some equally cogent reason. In one manufactory the women declared to me they suffered worse when they wore such dresses; the reason assigned being that they were more careful to keep clean their own clothes than the garments lent to them! And so on as regards the other special provisions made, to obtain the adoption of which in any degree requires constant pressure.

It is a well-established fact that some individuals are more susceptible to the poison of lead than others, and also that much depends on the observance of great cleanliness and on temperate habits. Some will work in white lead making for twenty years, and in red lead for a still longer period, without serious illness; whereas others fall ill within a few weeks of commencing employment. Of the females employed it may be stated that they generally belong to the least settled and prudent class of society, are largely natives of Ireland, and often, after a short term of employment, disappear. The changeable character of the population of lead works is further abetted by the laudable custom of discharging workpeople when they exhibit signs of plumbism.

D. *Silver extraction from Lead.*—This is a proceeding at times carried on in the same works where white and red lead are made. A modern process effects this by the superior attraction of silver for zinc. The lead is melted in large open caldrons or pans, and upon it are floated sheets of zinc, which attract the silver and form upon the surface a scum-like alloy. This is removed, and afterwards placed in a

reverbatory furnace, which burns away the zinc and leaves the silver pure. The only part of the proceeding suggestive of unhealthy conditions is that connected with the work done around the pans of molten lead, the vapour of which might be expected to produce the usual consequences. Very few men are employed, and those not continuously, in this process, and we were assured that they escape injury.

E. *Lead Paint* is, on the whole, by reason of its wide employment, more productive of disease than the manufacture of white and red lead. The mixers of paint, house-painters, the makers of floor-cloth, of linoleum, and similar materials for covering floors and stairs, and the artisans who dip Venetian blinds, are all and severally exposed to plumbism. Even painter artists have been known to suffer with it; an occurrence to be attributed either to peculiar susceptibility, or to indifference to cleanliness.

Lead occurring in oil paint undergoes vaporisation, especially where much turpentine or naphtha is used, as in the process of 'flatting' painted surfaces; a division of the painter's occupation recognised in the trade as especially harmful.

Lastly, the coloured salts of lead have diversified uses in the arts, especially the chromates, and are at times productive of mischief.

F. *Gilding of Wood, Stone, and Plaster.*—In these occupations, the gold as laid on in the form of leaf-gold is inert. The medium for applying it is not so innocent, and might possibly become a source of lead-poisoning, as it is composed of red and white lead mixed with turpentine; and there is reason for believing that the last-named substance favours the dissemination of lead when mixed with it.

SECTION II.—*Arsenic*, in its metallic form, is of small utility in manufacture, but its faculty of oxidation and vaporisation, and the soluble salts it forms, all of terribly poisonous properties, give it great importance both to the manufacturer and the physician. Its most widely used compound is arsenious acid. The production of this substance is described in the section on the smelting of metals.

Arsenic enters into the composition of some valuable alloys with tin and lead, and arsenious acid has numerous applications, especially in combination with other metals, with which it produces most brilliant colours. Arsenic acid also is employed, at times, as an oxidising agent in making dyes.

Arsenious Acid manufacture is carried on very extensively in mining copper, tin, and lead ores, especially the two former. Its centre is in Cornwall, but of its extent few persons who have not made particular inquiries, have, I believe, a conception. Dr. Albert Bowhay, who resides at Gunnislake, near the 'Devon Great Consols' mine, and has supplied me with an excellent outline of the manufacture, says that the works at this mine produce many thousand tons of arsenious acid yearly—probably more than all the other works in the country put together. The question forces itself upon the mind—where does all this most poisonous substance go, and for what useful and legitimate purposes is it employed? I have not sufficient information to supply an answer, but I partake of the surprise most people must feel who hear of so enormous a production of the poison. The ore from which the arsenic is extracted, is called 'mundic.' It includes also in its composition tin, copper, and sulphur. The first process, after crushing the ore, is one of roasting, or calcining, whereby the sulphur and the arsenic are driven off in a vaporous form, and conducted through long flues, in traversing which the arsenic is deposited as 'soot,' whilst the sulphurous acid passes on to a tall chimney, at the base of which a cascade of water is introduced to intercept some of it, and also any portions of arsenious acid which have penetrated so far. The solid material left behind in the calciner consists of impure oxides of tin and copper, which are shipped away to smelting works. The arsenious acid is removed from the flues, then crystallised, and afterwards reduced to powder for sale.

Dr. Bowhay says that it is the sulphurous fumes that escape when the calcining furnace doors are opened, which produce bronchitis. Those especially exposed to the poison, are the grinders and millers employed, but they, in my correspondent's experience, escape its constitutional effects.

This remarkable fact is to be accounted for by reason of the very slight solubility of arsenic, of its density, and of the care taken by the men to prevent its entrance into the respiratory passages and mouths, by plugging the nostrils with cotton wool, and covering handkerchiefs over the mouth, and by putting fuller's earth over the exposed surfaces. Moreover, Dr. Bowhay is convinced that the powder cannot be absorbed through a dry, sound skin, and that the crude ore itself is innocuous.

Speaking of the men who work on the surface, under sheds, he says they exhibit no special ailments; and the only workmen who do suffer are the calciners, as before noticed, who are exposed to the sulphurous fumes, and the millers and grinders, who get eczema and ulcers of the skin from contact with the arsenious acid. 'Nervous disorders,' he adds, 'are no more common, and epidemics are as common among the arsenic workers as other labourers.'

The eczema is commonly present in the folds of the neck, and around the nostrils. A scratch on the skin, or a slight abrasion on the foot, grows quickly into an ulcer, which can only be healed by the sufferer remaining away from the works for some time. The bronchitis supervening on inhalation of sulphurous acid escaping the calcining furnace is acute. 'The patient complains of a burning feeling in the throat and chest, and after some days, when the expectoration becomes copious, he finds relief, and the attack runs a normal course.'

The severity of the chest attacks, as above represented, suggests the probability that some small proportion of arsenical vapour, or of arseniuretted hydrogen, is mingled with the sulphurous fumes; for neither my own observation, nor inquiry made of others, respecting the labourers who roast the sulphur ores in sulphuric acid works, and get frequent inhalations of sulphurous acid, indicates that they experience bronchitis of like severity.

In connection with industrial occupations and diseases, the green arsenites of copper, known as Scheele's green, and Schweinfurt or Vienna green, occupy a foremost position. The brilliancy of these colours has led to their wide employment—for instance, in making wall and coloured paper, and

artificial flowers and fruits; in chromo-lithography, in decorating children's toys, and in dyeing textile materials. What is most reprehensible, they have even been detected as colouring agents for sweetmeats—an application, let us hope, made in ignorance of their poisonous properties.

But apart from their merits as colouring materials, arsenical salts are used on account of their poisonous qualities; for instance, in the composition of sheep-washes or dips, and in making 'fly-papers.' They are also said to have found their way into soap for the sake of colour, also into the composition of wafers and of a bronze powder used by lithographers. The employment of Scheele's green for colouring wall-paper, and artificial flowers and fruits, was specially investigated by Dr. Guy (see the *Fifth Report of the Medical Officer of the Privy Council*, 1862, p. 126 *et seq.*).

In making artificial flowers, the most objectionable process is that known as 'fluffing,' which consists in dipping the leaf into warm wax, and then powdering it with Scheele's green by means of a kind of dredger. Of necessity, such a process diffuses dust upon the workwoman, upon her clothing and hair, and surrounding objects. Other portions find their way under the nails and in the furrows in the skin; and in this way reach the mouth. Thus it happens that, by inhalation into the lungs, and by introduction within the alimentary canal, slow arsenical poisoning ensues, which is presently exhibited by chronic inflammation of the stomach and bowels, irritation of the eyes and skin, often also with accompanying eruption, great nervous debility, prostration, wasting, and the consequences of the gastro-intestinal lesion. Another method of applying the colour was by means of gum-water, but this effected no lasting adhesion. In colouring tarlatan, the arsenical dye was applied with starch; but here, again, there was no intimate union of the poisonous dust with the material; hence it soon loosened, especially in a dry, warm air, and was driven off in an impalpable form by the movements of the wearer.

In the instance of artificial flowers, as much as ten grains of white arsenic, on an average, were obtained from fifty leaves; and in 20 yards of a green tarlatan ball dress, Professor Erdmann got 100 grains.

I am glad to be able to report that the use of arsenical

colours in the arts mentioned, is greatly abated since its serious dangers were pointed out to the public; but it would be vastly more satisfactory to say that, as dyes, they are now wholly disused; but current newspaper records of disease caused thereby forbid the assertion.

Dr. Taylor (on *Poisons*, p. 353) writes:—'It has been lately announced that certain manufacturers of printed fabrics have substituted for albumen, the arsenate of alumina and a compound of arsenic acid and glycerine. In one yard of stuff there may be as much as from thirty to forty grains of arsenate of alumina. This has been specially observed in printed calicoes with a yellowish-brown or brownish-red pattern.' The arsenic is not in an insoluble form, for after a short immersion in water, some of it dissolves out.

Arsenical green is made in the open air or in enclosed shops. In the latter case, as might be expected, the symptoms induced by this unhealthy manufacture are greatly aggravated. Usually it is made in vats in the open air. Its derivation is from arsenite of soda, which is decomposed by sulphate of copper, and the resultant treated with pyroligneous acid. The ill consequences occur in the operation of drying, and in the carting and packing of the material, and are exhibited by the development of boils and pimples, and by an itching rash about the nostrils and in the flexures of the arms. In severer cases headache, thirst and nausea are set up, together with an irritating eruption on the scrotum. Some individuals, more susceptible to the poison, have vomiting, a quickened pulse, and conjunctival injection.

On the question of injury to health to the workmen in the calcining or 'burning' houses for arsenical ores, Dr. Ballard writes (*op. cit.* p. 257), the fumes produce 'gastric disturbances in some cases, bronchial and laryngeal irritation in other cases, and (this appears more common) an eruption about the genitals and on exposed parts of the body, especially at the flexures,' causing great annoyance.

Proust, several years since, showed that some tinned kitchen utensils conveyed the poison of arsenic to certain articles of food cooked in them. The same fact not long since received illustration in a large academy at St. Peters-

burg, where the pupils were attacked by an obscure illness, traced to the tin lining the cooking vessels, which was proved to contain 0·1 per cent. of arsenic. England had the discredit of these poison-bearing utensils, and of supplying an example of 'death in the pot.'

The use of the green arsenites in lithographic printing is not extensive. The colour is dusted on the prepared portions of the surface, and the excess afterwards 'flecked' off by a sharp tap. Both in these operations and in subsequent press-work, the artisans suffer somewhat, but to no serious extent if due care be adopted. The rashes and headache previously spoken of are the commonest symptoms, but may be complicated with epistaxis and gastric and intestinal irritation.

The tinting and staining of paper to be used for wrapping and ornamenting fancy goods, and also of wall-paper, is another industry in which arsenical colours are largely employed, and not only the greens, but also some buff pigments. The work soon affects the artisans, who cannot follow it up for any length of time together.

In paper-tinting the workmen are less exposed to the poison, as the colour is applied in a moist state; and, in the making of wall-paper, is more or less diluted with whiting. Nevertheless, some dust is thrown off, and the hands and exposed parts get besmeared or bespattered with the colouring material, and suffer therefrom.

In the making of ordinary coloured paper, the arsenic mixed with warm size and water, is rapidly spread by a brush. The paper is afterwards hot-pressed. In wall-paper making, large circular brushes are used, and when the paper is dried the patterns on it are hand-printed by blocks. If a flock paper be wanted, the flock is dusted on to a pattern printed in oil colours. When the printing of patterns is done by machinery more dust is generated, by reason of the colour being less 'sized,' and of the rapidity of motion.

The same poisonous pigments are at times used for wrapping-paper and for wall-paper in distemper colours laid on by brushes. As a matter of course, these distemper colours are readily detached and become diffused through the air.

The mischievous consequences do not end with those

concerned in manufacturing the paper, but extend to paper-hangers and to labourers engaged in stripping walls from their poisonous covering, and eventually to the occupants of the papered rooms. Arsenic is used by furriers, and also in making shot and enamels, and enters into the composition of glass and of several alloys, and at times in that of red lacquer.

This is not the place for detailing the variety of symptoms at large traceable to arsenical poisoning. These may be read in books on Toxicology, and are admirably told by Dr. Guy in the essay referred to, and from which we have copiously borrowed. There is this much, however, to be remembered: viz., that the poison affects individuals in very different degrees of intensity; that skin eruptions, oftener than any other signs, betray its action; that death very seldom follows its employment in the arts; and that the serious ills attending it may be greatly diminished by precautionary measures against inhalation, by ample working space and ventilation, and by rigid attention to cleanliness in work and of person. Nevertheless, its use should in every possible way be discouraged. Before closing this account of the industrial use of arsenic, we have to mention that it is employed as a preservative agent against decomposition in hides brought from India and elsewhere. Its poisonous results have been encountered, it is reported, in tanneries, but my own inquiries on this point failed to establish this assertion. This may be accounted for on the hypothesis that the arsenious acid has, in the course of drying, become so united and blended with the animal matter as to be inseparable from it in the handling of the hides; nevertheless, in the subsequent softening of them, prior to 'stripping,' we might expect the arsenic to be set free. Some day, probably, an instructed observer will discover signs of arsenical poisoning which, to the mind of the uninformed workmen, are treated as only casual appearances, and attributed to every other cause than the right one. This reflection applies, not only to the business in question, but to numerous trade processes as yet uninvestigated by trained medical observers.

An unlooked-for application of green arsenites was to colour the paper used for printing the 'greenbacks,'—the

securities so famous in the history of the United States civil war. The frequent handling of these paper notes by clerks at banks, and their occasional contact with the lips, is recorded to have produced symptoms of arsenical poisoning.

One use more, mentioned by Layet, for arsenical green, is in the making of false malachite; and doubtless, could the technical details of other products of human ingenuity be learned, the same energetic poison would be discovered latent in some of them. However, the sketch presented of sundry applications of arsenic in the arts, is sufficieut to put us on the alert against injury from it in all materials coming usually under our cognisance.

Dr. Ballard's researches did not bear out the popular notions respecting the wide diffusion and poisonous consequences of the smoke from copper smelting and arsenic calcining works. The destruction of surrounding vegetation appeared to him to be chiefly due to sulphurous-acid fumes. This opinion agrees with the statements of Dr. Thomas Williams, who wrote on the copper smoke of Swansea, which he showed contained an appreciable quantity of arsenic, but not enough to make its effects on the surrounding population apparent. In the process of 'cubbing,' in the course of copper smelting, when cold water is thrown upon a fresh-drawn mass of roasted ore, fumes of arseniuretted hydrogen are thrown off together with steam, sulphurous acid, and dust of a pernicious character.

SECTION III.—*Mercury or Quicksilver* is imported into this kingdom in a ready prepared state; but we read most sad accounts of those engaged in mining its ores and in extracting it in the metallic form. Such operations it is not our business to describe; but, it suffices to say that their effects upon health are of precisely the same character as those connected with the use of the purified metal and of its numerous compounds, varying, however, in severity according to the care used, the cleanliness observed, and, in some degree, to constitutional peculiarities.

Metallic mercury, notwithstanding its high specific gravity, has this peculiarity, that it gives off vapour at ordinary temperatures, and consequently exerts its injurious

energies on persons not actually touching it. It is employed in the separation of gold and silver from their ores, and in many industrial pursuits. Respecting its application in the latter, Dr. George Whitley contributed an excellent memoir, published in *The Sixth Report of the Medical Officer of the Privy Council*, 1865.

Mercury in its native form is a source of illness to philosophical instrument-makers, by its vapour, though we suspect cutaneous contact is the more important channel for its action. We can well imagine that a warm perspiring skin will not fail to act upon it, and produce a soluble salt capable of absorption. Of the ready absorbability of its compounds, medical men have ample daily experience. Its penetration into the system in its vaporous form must be exceedingly slow. Dr. Taylor, in his unsurpassed work on *Poisons* (third edition, 1875, p. 361) narrates a remarkable instance where the vapour was the poisonous medium. It happened in a vessel laden with the metal, the bags of which burst, and allowed its escape in all directions whereby its poisonous properties were experienced in an aggravated form among the crew.

Very few men are employed in making philosophical instruments containing mercury; and Mr. Negretti informed Dr. Whitley that, with temperance and cleanliness, its ill consequences were exceedingly rare.

The effects of mercury upon the animal system are sufficiently well known to make a long description of them unnecessary. The best-known symptom is salivation. Along with it is a greatly swollen tongue, with ulceration both on it and on the gums and cheeks, which may advance to destruction of tissue, or sloughing. The salivary glands swell, sometimes enormously; the teeth loosen, the breath acquires the mercurial fetor; there are colicky pains, nausea, and vomiting; general depression, and loss of strength and colour; with pains in the limbs, with occasional cramp and neuralgia, progressive tremor, and in very advanced cases, caries of bone. In chronic poisoning, as seen among workmen exposed to mercury, the leading phenomenon is the tremor, accompanied by pallor, wasting, gastric and intestinal

derangements and great weakness, or actual paralysis. Salivation may not be marked; but the gums usually are tender and spongy, and show a red edge against the teeth, which become carious and loose. M. Ferrand described the presence of a red cutaneous rash, lasting a few days, and much resembling that of scarlatina, as an occasional phenomenon.

It must not, however, be forgotten how widely the effects of mercury differ according to the manner and the agent operative in their production, and the acuteness of their onset, so much so, that no description of them will hold good in all cases. Those effects as witnessed in the industries noticed are of the chronic character, and are displayed primarily in the gums and teeth, and subsequently in the development of paralytic tremor. Professor Gallard makes the observation that it is only in chronic mercurialism that the teeth become discoloured and black. The tremor is intensified by intemperance.

A. *Silvering Mirrors* was accomplished by carefully laying and flattening a sheet of tinfoil upon the 'silvering' table, and pouring thereupon sufficient quicksilver to cover it. This done, the sheet of glass was skilfully slid upon it, and actively moved about, so that the mercury might unite thoroughly with the tinfoil, to form a film of amalgam upon the surface, of equal thickness throughout. In this operation, more or less mercury, and its amalgam with the tin was pressed out, and collected in vessels placed around the table.

The process caused the diffusion of metallic dust of great fineness, which co-operated with the vapour of the mercury employed, and became an active cause of poisoning among the workmen.

As an appanage to this process of silvering was one for recovering the mercury from the wasted tin amalgam, and also from the silvering of old mirrors, an occupation necessarily repeating the dangerous incidents of the original business.

Modern invention has happily replaced this process of silvering mirrors by one devoid of its terrible evils—viz., by precipitating metallic silver upon the surface of the glass from a tartrate of the metal.

B. *Water Gilding.*—In this business mercury is used as a medium for depositing gold upon the metallic surface to be gilt. The process consists in cleansing the surface from all extraneous matters, then washing it over with a solution of nitrate of mercury, and finally spreading over it an amalgam of gold and quicksilver. Heat is then applied to drive off the mercury, leaving the gold deposited. The final business is to burnish the gilt surface by rubbing it with hard stones, such as agates.

Electro-plating has very widely displaced water gilding, which, however, survives as a preferable plan in some kinds of work, as, for instance, in gilding sword-handles; and the impression prevails that gold deposited by the mercurial process wears better than that obtained by galvanic action.

Water gilding was never a trade that employed many men; but of those engaged in it practically all suffered mercurialism, more or less, notwithstanding that they worked but for two or three days together, and used mechanical and other precautions. Of such the most approved were enclosed glazed boxes or cupboards, so constructed as to allow the workmen to introduce their hands for the requisite manipulation. Another precaution consisted in wearing overalls of a glazed material. The enclosed working closets were available only when small pieces of ware had to be gilt; larger articles had to be done in the open shop.

C. *Furriers and Skin Dressers and Hatters* are another body of artisans exposed to mercurial poisoning. We cannot do better than quote Dr. Whitley's description of the process productive of the mischief. He writes (*op. cit.* p. 361): 'The skins, which are those of the common rabbit, or of a kind of American musk rat, the *Nutria*, are brushed on the hairy side with a solution of nitrate of mercury. This is done by men. . . . The skins are then dried in a close-heated room. They are then brushed by machinery, which is served by boys. Some of these have been thus employed daily for three or four years; but I could not hear of any case of mercurial poisoning amongst them. The skins are then cut by machinery, and afterwards sorted. This is done by women, who have to handle the fur constantly.'

Dr. Whitley, in the above extract, refers to two sorts of skins only as being treated with nitrate of mercury; but the fact is, that skins of all kinds are similarly treated. In the preparation of felt for making hats, the same material is used also. Another fact to be mentioned is, that it is not pure nitrate of mercury that is employed, but a mixture of that salt with arsenious acid and the bi-chloride (corrosive sublimate). The same or a similar mercurial compound is employed by taxidermists in preparing skins of animals to be stuffed and mounted.

Cases of mercurial poisoning among the employed in furriers' shops are, as Dr. Whitley's inquiries established, very uncommon. Nevertheless, it behoves medical men called upon to treat patients connected with the furriers' business, to bear in mind the sanitary incidents of the trade, so that they may understand symptoms that otherwise might be looked upon as inexplicable.

The first thing to be done for those afflicted with mercurialism, is removal from their employment. As a medicinal agent, sulphur stands first, given internally, and also used in the form of sulphur baths.

Section IV.—*Copper-Workers.* Copper smelting is an unhealthy operation, and has already received notice. The number of people engaged in working with pure copper in the cold state, are, in England, comparatively few.

Turning, filing, and polishing are operations productive of dust, and induce the usual respiratory disorders belonging to metallic dust inhalation. Like operatives in brass, so those in copper-work are, for the most part, known by acquired pallor, by leanness, and by the discoloration of their hair, and, some say, by greenish urine. Copper is with difficulty vaporised, but what vapour is given off is irritating to the respiratory passages, causing a choking sensation, with a metallic, coppery taste, and, in the case of brass-workers, may become a cause of nervous disorders.

The coloration of the hair is, as might be supposed, most pronounced among men whose hair is white or very fair. From my own inquiries, I entertain the impression that the particles of copper simply adhere to the hair, and do not

enter within the hair-cavity. However, some writers assert that they do penetrate within the hair, and that chemical analysis shows this to be the case. On this point, we would remark that, unless exceedingly great care be used to mechanically cleanse the hair, the detection of copper in the ashes will fail to demonstrate its localisation.

On the other hand, Layet quotes the case of a man with white hair who, five months subsequently to giving up working with copper, had his hair so vividly coloured, that he was compelled to remain in his home to avoid annoyance. Even this instance affords no proof of the penetration of copper within the hair tube, but rather evidence of the entrance of the metal into the blood, and its deposition by vital action within the tissues. Indeed, such an absorption is manifested, if Millon be correct, by the green colouring of the bones in copper-workers (*vide* Millon, *Bulletin de l'Académie de Médecine*, 1847, tome xii. p. 561).

But very possibly any such elaborate hypothesis is unnecessary to explain Layet's case, because, after all, the persistence of the colour might be due to neglect of means to thoroughly cleanse the hair.

As a blue line on the dental edge of the gums is so very characteristic of the presence of lead in the system, so, in like manner, is a greenish or purplish-red stain in the same position a prevailing feature of copper absorption. The colour, in the first place, is due to mechanically deposited copper, but, after a while, is assignable to the diffusion of copper salts in the blood, the metallic particles being acted upon by the acidity of the saliva, and thereby rendered capable of absorption.

When cupreous salts have thus found their way into the circulation, they produce their characteristic symptoms; foremost among which is colic, at times with vomiting. This colic, Blandet reports, to be attended by extreme prostration; and oftener with purging than constipation. The stools, says Blandet, have at first a greenish colour.

The molecules of copper may be seen in the air of a shop where filing and polishing are going forward, when a ray of sunshine passes across, by their scintillations; but these actually metallic particles do not, in the opinion of Chevallier

and others, operate poisonously on the economy. And the contention is that when copper-workers do suffer, it is from cupreous salts, especially the carbonate, which form upon old copper and brass. Nevertheless it is admitted that metallic dust may locally act on the respiratory and alimentary tract, and be productive of conjunctivitis and bronchial catarrh. Moreover, the investigations of M. Chevallier respecting the health conditions of the makers of *acetate* of copper failed to prove that any special inconveniences attached to this business; that anæmia was absent from among the men, and colic unknown.

With reference to these contradictory statements respecting the effects of copper upon artisans, the truth probably lies midway. The well-known poisonous properties of copper render it unlikely that it is absolutely innocuous to those using it. On the other hand, the serious group of symptoms described by Blandet are not to be looked for unless the artisans are reckless and dirty in their work and habits, probably introducing copper dust by means of food into the stomach. For my own part, I believe in the production of a copper colic, and am supported by the observations of the late Sir D. Corrigan (*Lancet*, Sept. 1854, and Jan. 1855).

It is worth while, in connection with the debatable question considered, to note that copper-smiths are exposed to the vapours of the solder used, which contains lead; and many of them also to the fumes of the tin employed in lining culinary utensils.

Clock-makers, according to M. Perron, of Besançon (*Ann. d'Hygiène et de Médecine Légale*, 2d série, tome xvi. p. 70), who have to handle copper freely, suffer a slow intoxication from it; exhibited by gastric derangements, diarrhœa, oppression, and some feverishness. And this same observer holds the belief that this poisonous action favours the development of phthisis, which, according to his statistics for the city of Besançon, was accountable for 127 of a total of 200 deaths among clock-makers.

My impression, however, is that the evils of copper-working occupied so prominent a place in the writer's mind, that he failed to take sufficient cognisance of the sanitary sur-

roundings of the artisans as possible causes of pulmonary phthisis, and to allow for the influence of dust on the organs of breathing as a factor of fibrosis.

A tolerance of copper fumes and dust seems to ensue in the case of old operatives. For the prevention of injury to health, the most obvious means are space and free ventilation. Colic is relieved by drinking freely of milk.

The ill effects of copper are much greater among those who clean and repair old copper vessels, boilers, and tubes; for in such work they detach by hammering the cankered scales and dust. To more effectually clean the metal, in the case of boilers, saucepans, and other utensils, preparatory to re-lining them, the workmen use scales of iron obtained from forges, which, by their hardness, are more effective than sand in rubbing off the 'copperas,' and so much the more laden with ills to the workers. Likewise in brazing, requiring the use of hard solder, the heat employed drives off vapour, which, on all hands, is admitted to be noxious. Braziers are reported to be a spare, unhealthy body of men, who are, in a large ratio, phthisical and short-lived.

SECTION V.—*Zinc Workers.* The processes connected with the recovery of zinc from its ores involve exposure to heat, which drives off some oxide, and to the generation of a certain amount of dust in mixing the argillaceous ore with the coal.

Considerable difference of opinion has prevailed concerning the action of zinc on those exposed to it. The latest contribution on the subject is by Dr. Schlockow (*Deutsche Medicinische Wochenschrift,* 1879, p. 208), and represents the results of ten years' inquiry among the zinc-workers in Silesia, where the metal occurs chiefly in the form of sulphide mixed with iron, aluminium, and lime. In the processes of separation, both vapour and oxide of zinc are thrown off, and find their way into the body by inhalation, and there unite with its fluids to form albuminates. The symptoms set up are cough and catarrh, gastric disorders, pallor with a dirty grey tint of the skin, dryness of conjunctiva, and night blindness. After work has been persevered in for ten or twelve years, there are exalted sensibility in the lower extremities, a feeling of burning

and gnawing in the feet, at times amounting to one of cutting the skin, and a sensation of tightness of the integument. But the lancinating pain of tabes dorsalis, and the girdle sensation around the belly are wanting. At a later period a feeling of coldness comes on, without any reduction of temperature, reflex sensibility increases, the patient cannot walk with the eyes closed, and the limbs are seized with tremor when moved; but there is no muscular wasting, only loss of contractile power. In the end, the upper extremities become flabby and useless. After death chronic inflammatory deposits were found in the anterior and lateral columns of the spinal cord. Neither colic nor constipation occurs, and the induction current shows increased excitability. Zinc, lastly, could not be detected in the urine. About 3 to 4 per cent. of the workmen suffered in the fashion described. As a class they seldom survive beyond the forty-fifth year.

Layet, on the authority of Bouchut, enumerates headache, disturbed rest at night, insomnia, lumbago, and nervous troubles, as consequent on the inhalation of oxide of zinc thrown off by heat (see p. 448).

Galvanizing Iron is practically nothing more than the immersion of sheets of iron, thoroughly cleaned by acids, in a bath of molten zinc. In this operation the workmen are exposed to the irritating gases evolved by the action of the acids on the iron, and to the fumes of sal-ammoniac—portions of which are thrown on the fused metal to arrest oxidation. The effect of breathing these mixed vapours is the production of a feverish state with nervous excitement, together with coryza, dyspnœa, sibilant chest râles, and blackish expectoration. At the same time, the nervous system is deranged, as shown by torpor, constriction across the breast, vomiting, and tremor and cramps in the limbs. The symptoms of poisoning are temporary and pass away by free diaphoresis and diuresis.

The metal used is the zinc of commerce, known as 'spelter.' To give the approved crystalline appearance to the galvanised surface, a small proportion of tin is added. A scum forms, consisting of spelter and sal-ammoniac, which it pays to deal with for the recovery of those substances. The

fumes caused by the galvanising process, rise and escape from openings in the sides and roof of the place of work, and have a mixed acid and garlic-like odour, the latter derived from arsenic contained in the zinc. To some people they prove suffocating, and cause general malaise, with headache and nausea.

Dr. Ballard states that the acid vapours have a peculiar smell, which he believes to come from hydrogen, generated by the acid acting upon iron-plates containing carbon. He adds a warning not to discharge the waste acid liquor or pickle into sewers.

Layet adds that the zinc galvanisers suffer with chronic dryness, and irritation of the nasal passages, and sores on the alæ nasi, which form crusts. The last he attributes to the presence of escharotic fumes of chloride of zinc.

Nothing has been said respecting zinc vapours, for it is not proved that such are given off. The zinc is not heated sufficiently to deflagrate or throw off fumes of oxide of zinc. Still it remains a question for chemists to solve, by testing for zinc in the vapours, and by spectral analysis.

SECTION VI.—*Brass Workers.* The manufacture of brass greatly surpasses that of its components, copper and zinc, in interest and importance, and has engaged the attention of many distinguished physicians, among whom, of late years, may be enumerated Dr. Headlam Greenhow, and Drs. Hogben and Simon, of Birmingham. The sanitary aspects of the brass industry cannot be studied without reference to the qualities of the components of the alloy, copper and zinc; hence may arise some repetition in the ensuing pages.

The sources of information, most largely used, are to be found in the papers by Dr. Greenhow in the *Transactions of the Royal Medico-Chirurgical Society* of 1862, in those by Dr. Simon, published in the *British Medical Journal*, 1888, and in the essay by Dr. Hogben in the *Birmingham Medical Review*, 1888.

Brass-founding and Casting is a process long recognised as a cause of disease, and particularly of a peculiar group of symptoms, known as 'brass-founders' ague.' Thackrah

described it, and more recently Dr. Greenhow, and Drs. R. M. Simon and Hogben, of Birmingham, the two last having unequalled opportunities of studying its phenomena. In my examination of the process at the factories, I had the great advantage of the company of the last-named physician.

The 'mixers' who bring together the two metals—zinc and copper—suffer most. The copper is first molten and the zinc then added to it, together with small quantities of lead and tin. Immediately the metals come into contact an intense action takes place, and some of the deflagrated zinc is thrown off in the form of heavy white clouds of filmy dust, consisting of the oxide of zinc. But, at the same time, the colour of the flame arising from the crucible indicates the presence of copper; and the impression got by breathing the vapour given off is that it is largely charged with copper. The workmen cover their mouths with cloths to avoid inhaling it, but they can far better tolerate it than those unaccustomed to it. Its effects are the production of tightness of the thorax, dryness of the mouth and throat, and irritation of the respiratory passages, with huskiness and asthmatic breathing. But it is not, in truth, nauseating. It is the new hands who suffer those severer disturbances which got the name of 'ague'; yet old operatives who cease from the work for a time, experience on returning to it a recurrence to some extent.

The so-called ague fit is ushered in by languor and depression; then prostration with pallor, cold sweats, and chills, that even may amount to rigors, with chattering of the teeth, præcordial anxiety, headache, nausea, and muscular pains. The onset of vomiting arrests the symptoms, and usually is followed by sleep, from which the patient arouses almost well. Drs. Greenhow and Hogben recognise a hot stage as preceding the sweating, but Dr. Simon has failed to observe it.

Now, although in the general sequence of phenomena there is a rude resemblance to that of intermittent fever, no real pathological relationship subsists between the two disorders. The brass-founders' malady has no such periodicity as Thackrah believed it to have, and Dr. Simon remarks that the symptoms are just such as would be produced by the injection of a quantity of an irritant metal, sufficiently

large to cause vomiting and its accompanying depression. However this may be, there is little doubt that the ague fit is a nerve-storm expending itself upon the sympathetic nervous system.

It is customary to attribute the disorder to the fumes of oxide of zinc. This was the view taken by Dr. Greenhow; but later writers believe that the copper vapour is equally, if not more, answerable for it. Dr. Stevenson observes a close relation between the effects of the two metals upon the human economy; and, as a result of recent inquiries, Dr. Hogben tells me that he is persuaded that the copper vapour has more to do with the phenomena in question than the oxide of zinc diffused through the air. He further urges that zinc administered in any known doses produces no like symptoms; that the vapour arising from that metal in the process of galvanising iron is devoid of them, and that, unlike lead, mercury, and copper, zinc does not accumulate in the system. But what is pretty positive evidence against the zinc hypothesis is, that similar symptoms of poisonous action occur among brass-workers, where no zinc vapour is thrown off; and, also, according to Thackrah and Claude Bernard, the like phenomena are met with in cases of chronic copper poisoning; viz., nervous derangements, palpitation, headache, cold sweating, shivering and various neuralgic pains, and gastro-intestinal irritation, with colic. This last, be it observed, is a phenomenon of copper, but not of zinc poisoning. Among French writers, Blandet and Bouchut (*Ann. d'Hygiène Publiques*, vol. xxxiii. and vol. xlvii.) accept the zinc hypothesis, whereas Tardieu rejects it as erroneous, and has the support of Rayer, Grisolle, and Chevallier. However, Bouchut affirmed that he had seen the same symptoms among the makers of oxide of zinc.

Over and above the production of the bastard ague described, brass-founding is charged with various other ill consequences to health. Among these, Dr. Hogben mentions the development of gout and chronic nephritis, with disinclination to active exertion, progressive paresis of the legs, tremor, muscular wasting, and, not infrequently, locomotor ataxy. He, however, equally with Dr. Simon, has not de-

tected the definite form of paraplegia spoken of by certain writers, nor the onset of paralysis agitans.

Respecting these various nervous disorders, indeed, no positive assertion can be advanced, and far more clinical observation is needed to pronounce upon their absolute connection with the occupation. In short, the known habits of intemperance pervading the artisans in question, suggest that they are answerable for some of the evils described.

To this account of English observers I will add the statements of Blandet, that brassfounders suffer a particular form of delirium, with hallucinations of hearing and of touch, accompanied by excitement of the sexual organs. In this account Blandet is unsupported by other physicians, and the idea crosses the mind whether 'absinthe' has not played a part in provoking such nervous disturbances.

In Chevallier's opinion, some nervous disorders noted among those employed in making alloys of copper with other metals, have been due to the presence of arsenic in minute quantity.

But besides brass-founding, there are other departments in the brass-working business that are damaging to health: and chiefly so by reason of the dust produced. These branches are brass-casting, turning, filing, and polishing. The soft nature of brass is opposed to the development of very fine and acuminated particles, and its weight to its rising very freely and to its diffusion in the air. Nevertheless, those turning and filing it show clearly, by their clothes and hair, that it is largely dispersed; the latter getting green, as happens with brass-founders.

The inhalation of brass dust operates in similar fashion to that seen in connection with other metallic dusts, provoking bronchial catarrh, which advances to bronchitis, and ends in fibrosis. It is reported by some writers that phthisis is unusually prevalent, but no reliable statistics are available to support this statement.

In estimating and explaining the consequence of brass-dust inhalation, the compound character of the metal is to be borne in mind, and we cannot, with certainty, predicate that the special properties of copper and zinc are obliterated in its formation. Besides, it is a further fact that lead is

introduced into its composition, particularly in inferior and soft qualities, and there are good grounds for believing that plumbism may arise from the dust of this admixture.

The other branch named of this manufacture is that of polishing, and is attended by a large evolution of dust. But here the dust is not purely metallic, but mixed with the powders used in polishing,—usually whiting and emery. The work is done on rapidly-revolving wheels, dressed with the necessary polishing material.

The contact of the skin with brass dust and with sand brings about eczematous eruptions.

Lacquering.—Subordinate departments are represented in the processes of dipping, lacquering, and bronzing. The last one is dealt with separately. Dipping consists in immersing the completed article in acids,—the nitric and sulphuric, diluted as required,—and, in their after washing, in a solution of soda. The acid-dipping gives rise to the evolution of irritant gases, which induce throat irritation, coughing, and, in the end, a form of bronchial asthma. At the same time, they operate as causes of gastric and gastro-intestinal irritation, with pain, and either constipation or looseness of the bowels.

When well washed, the brass goods are ready for lacquering, a process usually devolving upon female hands. It is a simple operation of brushing over the lacquer, a solution usually of shellac in spirits of wine, whilst the metal is hot. The fumes given off are a cause of headache, giddiness, loss of appetite, and some bronchial irritation, though, doubtless, these symptoms are, to a greater or less degree, owing to the heated and close workshops.

Brass-workers, as a class, are lean, sallow, and unhealthy-looking, and frequently suffer with anæmia and obstinate dyspepsia. Cessation from work for a short period, or their transference to the iron-workers' shops to turn and file iron, soon re-instates their health. The men engaged in cleaning castings and old brass tubes encounter mineral as also dis-

tinguished from metallic dust, and suffer more in their breathing.

Another lesion of brass-workers is stated to be enlargement of the spleen, without tenderness. This is a matter, like that also of the relative prevalence of phthisis, which demands original and careful inquiry.

In estimating the effects of the occupation under notice, it is clear that the collateral circumstances attaching to it must be kept in view. Intemperance is an evil of no small magnitude among the workers, which, besides its own train of ills, aggravates those belonging to the occupation; viz., strong bodily exertion in some branches, excessive heat, exposure to fumes of various kinds, and to dust more or less poisonous.

The obvious chief remedy against the inhalation of the products of brassfounding is ample space and ventilation for the process. Too frequently these sanitary requirements are absent in existing foundries. The evils of turning, filing, and polishing are equally avoidable by adopting mechanical arrangements,—by fans and tubes for withdrawing the dust as it is generated at the machines, and by a constant supply of fresh air.

No visitor to the Birmingham establishments, speaking generally, where brass-making and working are carried on, can come away without the conviction that a great deal remains to be done to render them healthy places of manufacture.

SECTION VII.—*Tin.* The pure metal is exempt from any harm to those working it; and its dust will play a very insignificant part in producing disease. The work of the tinman has indeed nothing but accidental conditions detrimental to health; such, for instance, as the fumes of solder and of hydrochloric acid employed in soldering, and the fumes of the braziers filled with burning coke, which are frequently employed for heating the soldering tools and other purposes. There are, however, salts of tin of distinctly pernicious properties, and some of them are in use by dyers. Mr. G. H. Metcalfe furnished a history of some cases of

poisoning he attributed to tin, or rather to a salt of the metal formed by the action of malic acid upon it. Stated in outline, the history was of four cases of decided illness following upon eating cherries preserved in tin boxes. The symptoms were those of very severe gastro-intestinal irritation, indicated by pain, nausea, vomiting, diarrhœa, and collapse, and in one instance, cramp.

Analysis showed the juice in the tin to be very acid from the presence of malic acid, and that tin itself was present as a malate, in the proportion of 3·2 to the fluid ounce. What seemed remarkable was, that the general surface of the interior of the box showed no corrosion, which was confined to the solder—a fact Mr. Metcalfe explained by assuming a galvanic current to be generated by the presence of the lead in the solder.

Though Mr. Metcalfe's cases put malate of tin on a footing with chloride of tin (found in 'dyers' spirit') as an irritant poison, the impression will force itself upon the mind that the tin may not have been chargeable with the whole of the symptoms, remembering that lead was present along with an acid juice, developed by fermentation, and that possibly a trace of arsenic existed in the tin itself. But if tin cannot be reckoned a noxious metal by nature, the manufactures in which it plays a leading part are not devoid of injury to health. The chief industry is that of making tinplates, and belongs especially to South Wales, where it gives employment to many hundreds of persons, both male and female. I will deal with this manufacture in this place, although it would find a suitable position in the chapter on elevated temperature, inasmuch as exposure to heat is a leading phenomenon of tinplate-making.

Tinplate-making.—The vast number of articles, in common parlance made of tin, are nothing more than thin iron or steelplates coated with tin. After sundry heatings and rollings, the desired thin plate of steel or iron is produced, which, after undergoing a process of doubling, is next dipped into pickle tanks, filled with sulphuric or hydrochloric acid and water, in order to scour the surface. When sufficiently cleaned it goes to the tinman, who first immerses it for a

brief period in a bath of palm oil, and then dips it into melted tin, which thereupon unites with the iron, and inseparably coats it.

This outline of the manufacture of tin-plates will suffice to illustrate the conditions which affect the health of the employed. They are represented chiefly by exposure to heat, to the fumes of tin, and of the acids used in cleansing the plates. Immersion of the hands in the acid baths whitens and hardens the skin, and makes it liable to cracks and excoriations. The acid vapour reaches the eyes, nose, and throat, and irritates or inflames the mucous membrane. The teeth suffer decay, and the gums get red and soft; an acid dyspepsia is generated, and toothache is common.

When the tinning of the plates is completed, a process called 'branning' follows. It is done by women, while the plates are still hot, and develops clouds of dust obnoxious to the lungs.

In olden time, tin had a bad reputation as a cause of various disorders to those working with it, such as colic and paralysis; but the accusation was unjust, forasmuch as the evils noted proceeded not from the tin itself but from associated metals, lead and arsenic, conjoined with it in nature, or combined by art. For example, the preparation of tin from its ores is occasionally injurious to the workmen owing to the contained arsenic. So again in making 'mosaic' gold the artisans are subjected to the vapour of mercury; whilst in making pewter they are exposed to lead-poisoning.

Dyers, likewise, are brought into contact with tin in combination with nitric acid forming what they call 'composition' or 'physic'; but here also, what ills they suffer originate from the acid and not the tin.

Section VIII.—*Bronzing* finds a place in this chapter on poisonous materials, for this reason that the substances used to effect it are very frequently actually poisonous. Bronzing simply means the production of the appearance of bronze in materials devoid of true bronze. The last-named is an alloy of copper and tin, with some admixture of zinc or at times of lead, and in itself has no obnoxious qualities;

moreover, its production involves no other cause of disturbed health than that of great heat necessary to its casting. In casting bronze statues, probably exposure to extreme heat surpasses that connected with any other operation.

The hurtful consequences of 'bronzing' depend upon the solids or fluids used to develop the required colour; and these, in their turn, are regulated by the nature of the material to be bronzed.

When common objects in plaster and wood are to be bronzed, they are covered with a layer of varnish or glue, and upon this the powder is dredged. A powder commonly used is a copper precipitate with which arsenic may be mixed. In bronzing metal, usually brass, the operation consists in depositing copper upon the surface, in combination with some other substance to vary its colour. In making black and green bronze, the articles are immersed in acid with sal ammoniac, or with arsenic and sulphur.

No attempt is made at technical details, but only notes sufficient to indicate where, and in respect of what material, injury to health may arise. In the business in question, we observe one source in the acid fumes given off in the preliminary cleaning of metal surfaces, and another in the employment of arsenic or other mineral poison. When silvering is required, mercury in combination with bismuth and tin is used.

In its diffusion over the surface of the article to be bronzed, the dust falls upon the hands, faces, and clothes of the artisans; and is apt to be licked from the lips, and so transferred to the digestive canal. On the lips and face, the powder at times produce eruptions and ulcers. As a matter of course, these consequences will differ according to the composition of the bronzing material.

Nickel Bronze.—This is an alloy of copper and nickel, of a silvery colour and lustre, and is used for making stew-pans and other kitchen utensils of superior character. It has the disadvantage of being acted upon by acids and alkaline salts. Organic acids seem the more active; the result is that a certain amount of decomposition will ensue where acid food remains long in contact with the metallic

vessel, and the more so when it is covered up. Soup containing onion is stated to set up decomposition more easily than other foods,—a fact attributed to the trace of oxalic acid present in onions.

Utensils in bronze and brass are charged with like deleterious consequences (*vide* Garnier *On Kitchen Utensils of Bronze, etc., Ann. d'Hygienè Publique,* vol. xxiv., 1890).

SECTION IX. *Phosphorus.*—The interest attaching to this material in its industrial applications centres in lucifer match-making. The frequent and serious sufferings of those engaged in this trade soon drew attention to phosphorus poisoning on the part of various Governments, as well as of individual inquirers and philanthropists. In England, Sir John Simon secured the able assistance of Dr Bristowe to investigate the subject, and printed the conclusions arrived at in the *Fifth Report of the Medical Officer of the Privy Council,* printed in 1863. Having no better authority, we shall chiefly rely upon this very satisfactory official document.

The manufacture of phosphorus from bones is a chemical process that here needs no description. It is enough to say, that arrangements are made for at once carrying off and burning the gaseous emanations from the retorts, which otherwise would be very poisonous. Accidental escapes of phosphuretted hydrogen, and probably of a little phosphorus, will now and again take place, but carry with them no serious results where ventilation is good. Moreover, the number of men occupied in the making are very few.

But it is not so when the material is to be applied in match-making. Here a large number of hands are concerned, and many among them are exposed to the evil effects of its vapour. Women and children greatly preponderate in the staff of workers in match factories.

Dr. Bristowe distinguishes several kinds of matches in which the proportion of phosphorus to the chlorate of potash and other materials differs considerably, and points out that in Bryant and May's 'safety matches' the phosphorus is spread upon the boxes. and is of the amorphous form.

The wooden splints or stems of the matches are first

slightly charred at the end upon which the composition is to be fixed; then are dipped in sulphur, paraffin, stearine, or some analogous substance. In the case of common matches, these are collected in bundles, and the phosphorus paste affixed by simple dipping; but for the better class, the wood splints are first fixed separately in frames or clamps, to secure a more even and equal application of the composition.

This composition consists essentially of phosphorus and chlorate of potash combined with glue. Accessory substances are powdered glass, and colouring agents, such as red-lead, sulphuret of antimony, Prussian blue, vermilion, and black oxide of manganese. The component substances are first ground, and then combined by stirring in the glue, previously melted in a steam bath. By this their union in a moist state, the risk of explosions is avoided. Drying follows next in drying-rooms, artificially heated and fire-proof.

As first produced, matches tied in bundles are double the length intended, in order to facilitate the dipping, by alternately presenting their opposite ends. Hence they require 'cross-cutting,' an operation that demands care to avoid ignition. Boxing is the terminal proceeding.

The making of wax vestas, of fusees, and Vesuvians differs in no respects, in a sanitary point of view, sufficiently to call for a description of the minor peculiarities attaching to it. It is only the use of phosphorus that gives sanitary importance to the trade. Hence we may anticipate that the departments of the business in which mischief to health arises are, the mixing of the explosive or igniting substances, the spreading of the composition on a warm surface for the carrying out of the operation of dipping, and lastly the drying. Moreover, the abiding tendency of phosphorus to emit vapour is evidenced in all the shops where the completed matches are present, and, consequently, these places cannot be wholly exempt from its effects. And, as a matter of course, the amount of phosphorus in vapour will depend chiefly on the proportion employed.

Thus it happens, as Dr. Bristowe writes, the best 'frame-matches' yield less fumes, as do also those armed with sulphuret of antimony as contrasted with those coloured by Prussian blue. But the most important fact is, that when

amorphous phosphorus is employed there are no fumes, and the serious accidents of the business are reduced to a minimum.

There is yet another manufacture of recent invention, in which phosphorus is employed in very large quantities; namely, in making phosphor-bronze. It is a very limited trade; and dealing with the phosphorus itself is reserved to some one responsible individual in authority. There is no persistent diffusion of phosphorus fumes, and, hitherto, no health troubles have been identified as belonging to the manufacture. The use of phosphorus in chemical laboratories calls for no special notice.

The particular morbid result following exposure to phosphorus fumes is necrosis of the maxillary bones. Usually the first complaint among the match-makers is toothache, which, though relieved by extraction of teeth, is not cured, but speedily followed by ulceration, death of the subjacent maxillary bone, and thereupon all the usual signs of necrosis, —fetid suppuration and destruction of tissue, hectic and fatal exhaustion. The progress of the disease varies in rapidity from six months to two, or even more, years, when the sufferer perished from debility, with some intercurrent disease, such as phthisis. Its attendant symptoms are feverishness, loss of appetite, constipation, sallow pasty skin, and more or less pain. The lower jaw is the more frequent seat of the lesion, and exhibits far more vigorous attempts at repair than does the upper maxilla, when the necrosed portions are removed. The reason of this becomes evident when it it is remembered that the upper maxilla is but a thin shell of bone, whereas the lower is thick enough to contain within itself an ample supply of vascular and osseous tissue for vigorous existence and repair after injury.

The management of phosphorus necrosis is the work of the surgeon, who can cut away the dead bone, and thus usually arrest the advance of suppuration, with its destructive effects upon the general health, and permit nature to pursue her work of healing, provided the patient cease from his unhealthy occupation. Phosphorus is further used as a vermin-killer, but the proportion in which it is combined

with other ingredients seems to be, according to Dr. Herapath's analysis, only 5 per cent. Besides by being mixed in a moist state, this small percentage develops no known injurious vapour.

The amorphous or red phosphorus gives off no apparent vapour, is devoid of smell, and seems to possess no very distinct poisonous properties. That it is not solely used in all cases, is owing to the fact that the paste made with it is less readily inflammable than that which contains more or less ordinary white phosphorus.

The now greatly improved buildings erected for match-making, coupled with the substitution of amorphous for ordinary phosphorus, have happily rendered examples of necrosis of the jaws uncommon. In Dr. Bristowe's opinion, the lesion, since its recognition has been far less frequent in England than in continental states, owing to better observance of sanitary laws, and still more, to the smaller proportion of phosphorus present in the composition. Although the peculiar disease of the jaw does occur among other artisans exposed to the fumes of that element, it is comparatively uncommon. But even match-making is not incompatible with a good share of health, and with life of average duration, provided always the workpeople are sound when they take up the occupation, and that they rigidly attend to cleanliness, and work in well-ventilated rooms.

Some individuals escape the injury, and much discussion has arisen concerning the cause determining its occurence. The existence of carious teeth is the hypothesis that has had most supporters, and, by the rules approved by the Factory Office, children and young persons with diseased teeth are considered ineligible for employment in match factories. However, Dr. Bristowe only partially acquiesces in this hypothesis, as he found necrosis to have been set up in some operatives whose teeth were sound, whilst others with carious teeth had escaped the lesion.

He also ventured on the broad statement that, with the exception of the maxillary disease, workers with phosphorus suffered no other evil attributable to that substance. A very different picture is drawn by foreign writers, who find a host

of disturbances of health among those people. We may so far agree with the latter, that those employed in match factories look sallow and unhealthy, and are prone to gastric disorders. But, as just said, English experience does not bear witness to the many other evils ascribed to phosphorus;—of such are nervous disorders, progressive mental weakness, headache, and irritation of the respiratory passages provocative of cough. Another statement is that the breath becomes phosphorescent. In short, I concur with M. Tardieu that these graver accompaniments of phosphorus match-making are due less to that substance than to insanitary surroundings and the want of care and cleanliness.

Besides scrupulous attention to cleanliness and ample space and ventilation, the best prophylactic is the vapour of turpentine, as was pointed out by the late Dr. Letheby. The fluid turpentine should be suspended in open vessels about the workroom, so that its vapour may be generally diffused. Cases also are on record where turpentine has been administered internally in phosphorus necrosis with benefit.

M. Lévy, speaking of the prevalence of phosphorus necrosis (*op. cit.* p. 902), says that, in the course of ten years, of a group of match-makers, ten per cent. suffered with it. The majority were women, but this fact is accounted for, because the large majority of the employed were females. The disease he found to be rare, until the work had been carried on for three or four years, or a still longer period. The fumes when examined proved to be hypophosphoric acid, with occasional traces of phosphuretted hydrogen. Bucquoy reported the case of a woman who worked for eighteen years before necrosis supervened; but after her death, all the viscera, except the lungs, were found in a state of fatty degeneration. Fatty liver has been held to result from chronic phosphorus poisoning; this lesion is, however, very rare.

SECTION X.—*Sulphur* in its industral applications inflicts no such serious consequences as does phosphorus. In the process of grinding into powder, and when in the shape of powder, it acts upon the skin, causing irritation and redness

with great dryness, and a tendency to desquamate. Sulphur grinders also experience conjunctival irritation and inflammation; and, by penetration of the dust into the alimentary canal, anorexia and looseness of the bowels supervene. Authors also attribute insomnia to its action on the nervous system, and more or less bronchitis, as a sequel to its inhalation over a long period.

Dr. Richardson quotes from the researches of Mr. Bonisson of Montpellier, the symptoms suffered by the labourers employed in sulphuring vines invaded by the oidium. Here it is the sulphur in fine powder that acts, producing pain, redness, and swelling of the eyes; or, in a word, a slight ophthalmia. The effects are worse in the middle of the day when solar heat and radiation are most intense, and women and children suffer most (*op. cit.* p. 147). In this instance, we have conceivably the joint action of sulphur vapour and of the powder of sulphur. The latter is known to provoke eczematous and erythematous eruptions of the skin by its topical action, along with conjunctival injection and bronchial irritation. The consequences of the operation are more severe when lime is mixed with the powdered sulphur.

But it is in its combinations with oxygen that sulphur possesses the greatest interest. The ready combination of the two elements when sulphur is ignited, is very notable. The result is sulphurous acid, which possesses strong bleaching properties, and is highly destructive of animal life. Hence its value as an antiseptic and destroyer of contagion.

Its bleaching properties are largely resorted to by dyers and bleachers, and by straw-hat and bonnet makers. In these occupations the chief danger arises from its suffocative property; but primarily it causes dryness of the throat, huskiness, and spasmodic cough, and after prolonged exposure, chronic bronchitis. Some writers add to the list throat angina, broncho-pneumonia, and rebellious dyspepsia, with watery blood and anæmia.

With a further dosage of oxygen, sulphuric acid is obtained, which is readily reduced again to sulphurous acid on uniting with metals, earths and other substances, by parting with a portion of its oxygen. An example of this decomposition of sulphuric acid is met with in the separation of gold and silver

from the copper existing in their ores. But it is of such perpetual occurrence in chemical works and laboratories, as to need no further notice.

Further remarks on acid fumes occur in the chapter on noxious vapours.

A. *Sulphuric Acid.*—The manufacture of *sulphuric acid* is one of the largest chemical operations carried on. It is enough to say that it is obtained by roasting sulphur or sulphur pyrites—the latter at the present time almost exclusively. The sulphurous acid, replenished with additional oxygen from nitrate of potash, is transmitted into large leaden chambers, through which steam is driven, whereupon sulphuric acid is presently formed.

The pyrites is roasted in specially-constructed ovens or furnaces arranged in two, three, or four tiers, and is passed on from one furnace to another, until the whole of the contained sulphur has been expelled in the shape of sulphurous acid.

The excellently-contrived ovens in the best manufactories with close-fitting sliding doors, render the process harmless to health, for it is only on the necessary occasions of opening a door that noxious fumes in any distinct quantity escape. Moreover, one or two men can attend to a long row of furnaces.

In the subsequent transmission of the sulphurous acid into the leaden chambers no evils arise, except from accidental leakage. Notwitstanding, to those unused to the business, there is a perceptible diffusion of the odour of sulphurous acid about a factory.

A considerable amount of temporary injury, and even loss of life, will occur when the chambers are empty and require to be cleaned out. Such accidents are usually the consequence of recklessness in entering the chambers too soon, and before the sulphurous acid has fully escaped. To obviate them, the doors are opened for a length of time and water injected. Afterwards a layer of sawdust is spread over the floor, which, together with whatever sulphate of lead has been formed, is presently removed by labourers. These men take care to cover up their mouths, and are supplied with

specially strong-made high boots, resembling those used by watermen. The danger of the operation from the sulphate of lead present is comparatively trifling; but arises rather from the intimate intermixture of the sulphurous acid with the deposit on the floor of the chamber, and its being set free by mechanical disturbance.

The evils of lead are more severely felt by the plumbers, who find constant work in making and repairing pipes, funnels, and chambers; and are exposed to the fumes of the solder they use, as well as to the metallic lead itself.

The Spanish pyrites, which is most in use, contains, besides the sulphur, both copper and arsenic. The amount of copper conbined makes its extraction profitable, and consequently the residue of the roasted pyrites is sent to the copper extractors. The arsenic is abstracted from the sulphuric acid by the medium of lime; the separation is difficult, and much arsenic remains as a waste product in union with the lime. The process being a wet one, offers no distinct health features.

B. *Sulphur recovery process.*—In the course of chemical manufacture a considerable proportion of sulphur becomes united with other matters, and has, until of late years, been treated as waste. However, as sulphur is a valuable commodity, invention has been brought to bear upon its extraction from waste material. The approved plan for effecting this is known as the sulphur recovery process, and is effected by the medium of sulphuretted hydrogen. The process is carried out on a gigantic scale at a few manufactories, by most elaborate mechanical and chemical constructions and apparatus; but experience with it has been too brief to admit of conclusions as to its health features. What strikes the observer is the enormous accumulation of poisonous sulphuretted hydrogen in reservoirs, and the possible danger of bursting or explosion.

SECTION XI.—*Chloride of Lime* is made on a very large scale, and employed chiefly for bleaching, and also as an antiseptic for sanitary purposes. The first stage in its

manufacture is the production of the hydrochloric acid, from which the chlorine is derived. It consists in the decomposition of common salt by sulphuric acid, and the process usually pursued is that known as the Leblanc process, originally employed for making soda, but now valued for its utility in the production of hydrochloric acid. The making of soda is at present chiefly conducted by the ammonia-soda process, in which hydrochloric acid is not generated.

To get hydrochloric acid the chloride of sodium is placed in furnaces, and the sulphuric acid added to it. The decomposition is facilitated by heat, and the result is hydrochloric acid gas, and a refuse mass known as 'salt-cake'—and, in fact, a sulphate of soda. The gas is conducted by pipes to a high tower filled with coke, through which a stream of water trickles. By this arrangement the gas is condensed, and flows down to the bottom of the tower in the shape of fluid acid. The next step is to detach the chlorine. This is done in stone stills by the agency of the oxide of manganese, which sets free chlorine ready for transmission to an accurately-closed chamber, where it is brought into contact with slaked lime spread over the floor to the thickness of two or three inches. In the course of several days, the chlorine is absorbed by the lime, and bleaching powder formed ready for use. In this operation no heat is employed, though much is generated chemically.

The manufacture thus briefly described is charged with operations damaging to health. The production of the salt cake in the furnaces exposes the workmen to acid fumes and to extreme heat, for they have to watch the contained mass at frequent intervals until their experience tells them the hydrochloric acid has been given off. The next business is to remove the salt-cake from the furnace, an operation exhaustive by heat, and injurious by some portion of still adhering gas, which escapes as it is wheeled away in barrows in a still heated state. It will be at once perceived that the evils from this cause are readily avoidable by the adoption of arrangements for a preliminary cooling of the salt cake when raked out of the furnace.

The processes connected with the production of the

chloride of lime and its removal from the chlorine chambers are still more prejudicial. The lime used has first to be slaked and sifted, and afterwards spread evenly over the floor of the chamber, operations attended by the throwing off dust to an injurious extent. To protect themselves from its inhalation, the labourers cover more or less of their faces with flannel or other material, and use oil freely on all exposed parts. At the same time they are careful to avoid cleansing themselves with water, which would with the adherent lime produce severe burning and scalding. As it is, the lime dust sets up painful conjunctivitis and irritates, dries and excoriates the skin.

It has been seen that the lungs can dispose of a certain amount of lime dust by a sort of appropriation or digestion, by the agency of the carbonic acid they contain; but in the case of the labourers in question, the quantity of caustic dust is too great to be tolerated, and in consequence these men suffer bronchial irritation, and develop bronchitis with progressive damage of pulmonary tissue, evidenced by cough, expectoration, and severe dyspnœa. What intrinsic alterations of tissue are produced, no British pathologist has had the industry to search for.

The removal of the chloride of lime from the chambers is a still more serious business to the workmen. A preliminary requirement is that the labourers engaged in it are vigorous and healthy men; for none but such are qualified to endure the hardships of the occupation. As the business is piece-work, the labourers are anxious to accomplish the largest amount in the shortest space of time. This, unhappily, leads to an aggravation of the evils inseparable from the work. It encourages the men to enter the chambers before the chlorine gas is sufficiently dissipated, and to extend the time spent in them to the utmost of endurance.

Whilst working in the chambers, they envelope the neck, mouth, and nose in several folds of woollen cloth, wear huge goggles, and bandage their legs with folds of thick brown paper, fastened by string. In a very brief period, these protecting investments become completely rotten, and fall to pieces.

The dense wraps over the nose and mouth almost com-

pletely prevent breathing, and it is only by practice that the men can carry on sufficient respiration to sustain life. Even as it is, they can remain only a brief time within the chamber, and have to seek for fresh air outside. On their exit, they are seen to be sweating profusely, and greatly exhausted, gasping for air, with inflamed eyes, and highly reddened skin, whilst mucus streams from the mucous membrane of the nose and air passages, accompanied by cough. They are, in short, in a state of partial suffocation, with congestion of the lungs induced not only by the gas, but also by the impediment to breathing from the dense protecting bandages over the face. For a few seconds the necessity for admitting air within the lungs precludes speech, but, after a short period, by the action of outside air, and diligent wiping away of the sweat, they get sufficiently refreshed to return to their painful labour.

It takes time to get inured to this toil; and there are some men who seem to be unable to become so. At one factory I visited, out of a dozen labourers, two men had worked for about ten years. Some two or three looked well nourished, but the rest were thin and seemed jaded out, pale, and sallow. They are recruited from the rough and reckless stratum of society, mostly of Irish nationality, and the greater number of them are dissipated, believing in the virtues of whisky, with which their good earnings enable them to supply themselves liberally. Taking the above circumstances into consideration, it is no marvel to hear they are short-lived.

Trade requirements demand bleaching powder to have a fixed charge of chlorine; this is one reason why the casking is often done within the chambers themselves, inasmuch as if performed outside—so some makers assert—it would lose more or less of the gas, and be deprived of value as a bleaching material. However, I have visited works where the chloride is shovelled down a shoot into a cellar beneath, where it is received into the cask; the end of the shoot and the mouth of the cask being surrounded by a coarse cloth, arranged to prevent the dispersion of the dust. This is certainly a better plan than that of men entering, and by painful effort filling the casks within the chamber. It lessens the number of those who must enter within it, and also the time to be spent in an irrespirable gas while casking goes forward.

When the labourers get an overdose of the chlorine, they are said to be 'gassed.' This is not of frequent occurrence, but now and then it ends fatally. When it happens, it must be attributed almost always to recklessness. One of the immediate effects of the gas is the breaking out of a papular eruption on the exposed parts of the skin, against which the men provide by freely smearing themselves with grease. The eyesight, likewise, is prone to suffer by the reiterated attacks of conjunctivitis; whilst the irritation of the mucous membrane of the bronchial tubes sets up after a time bronchitis, and eventually a lasting asthmatic state. The cough, as in analogous dust-produced diseases, is at the first confined to the morning, when a blackish expectoration relieves the obstructed breathing. One further consequence of the occupation is the destruction of the enamel and frequently of the dentine of the teeth.

It has been represented, but not on sufficient grounds, that chlorine workers are predisposed to phthisis. They, however, get thin, and lose colour. The wasting can be accounted for without calling in the special properties of chlorine to explain it, by the exhausting nature of the employment, the profuse sweating, and the prevailing addiction to alcohol. This last fact is not to be wondered at, considering the exhausting character of their work and the craving for something to revive and stimulate them, since the advantages of nourishing food are not appreciated when appetite is destroyed, as happens with these labourers. What is wanted is a diffusible stimulant to help the labouring heart, and to aid respiratory action to overcome the pulmonary congestion.

I have not witnessed any attempt to rescue the labourers from respiring the chlorine; but it seems to me that this end might be attained by the wearing of a light helmet over the head, similar to that worn by divers, made of some material not acted upon by chlorine, such as thin metal, or gutta-percha or cellulite, and into which a constant supply of fresh air should be driven from without. Such an apparatus would enable a man to enter and carry on his labour for a considerable time together; particularly when some protective covering for the body is also provided. Exhaust-fans to

withdraw the gas would contribute immensely to remove the evils, but, I apprehend, the use would be objected to as robbing the chloride of its due proportion of gas.

SECTION XII.—*Cyanide of Potassium* has its use in the arts, being employed in electro-plating and in photography. In the former business, it is used as a solvent for the metals, and in so acting, throws off poisonous vapour resembling in all particulars that of hydrocyanic acid. Its evolution is promoted by heat, and its effects by neglect of ventilation. It produces a feeling of severe illness, with headache, vertigo, noises in the ears, and other signs of disturbed cerebral circulation. Afterwards the breathing becomes difficult, there are pain in the cardiac region, constriction of the throat, and palpitation.

Dr. Richardson (*op. cit.* p. 204) describes the case of a photographer in whom the cyanide had been absorbed through chaps in the skin of the hands. The primary symptom was giddiness, with a feeling of falling forward and of failure of the legs to support. In worse cases, there are nausea and faintness, and, 'under still further exposure, the body becomes cold, and extreme shivering takes place, which is succeeded by a prostration that altogether incapacitates from work, and is succeeded by a series of new nervous phenomena of great moment. The first of these nervous signs is double vision,' and afterwards muscular tremors accede with startings and twitchings of the limbs. At the same time, 'the temperature of the body is lowered, and the appetite is greatly reduced; the secretions are confined, the face pale, the action of the heart quick and irregular, and the sense of exhaustion urgent. The mind throughout is unaffected, but there is perhaps an unusual tendency to sleep.'

It would seem that the cyanide cannot enter the system through the uninjured epidermis. On the other hand, it is accused of producing ulcers on the hands of electroplate artisans, with fissures about the joints. Dr. Taylor (*op. cit.* p. 627) remarks:—'The strong alkalinity of the solution would explain some of these effects, for the solution readily dissolves the cuticle, and exposes the true skin.'

The cyanide is also an occasional ingredient of plate

powder, especially of that description called 'argentine,' and used for silvering metallic plates. It is united with cyanide of silver and chalk, and the compound is decidedly poisonous if it finds its way into the circulation.

SECTION XIII.—*Cadmium.*—Salts of cadmium are at times used in plate powder. Dr. Richardson refers to this fact, and quotes Dr. Lovet as the first person who had called attention to the ills arising from those salts, and recorded three cases in illustration. The symptoms noted were of a choleraic type, with giddiness, difficulty of breathing, vomiting, and diarrhœa. There was great exhaustion, with cramps in the legs.

The white carbonate was the preparation used in these cases; but the green sub-oxide and the yellow sulphide are employed in the arts as pigments.

SECTION XIV.—*Chromium Compounds* are largely used in the arts as colouring matters. The bi-chromate of potash is widely employed by dyers and by chemical manufacturers in the production of other chrome salts. The chromate of lead is very widely used on account of its rich yellow colour; and this property has tempted persons to use it to colour confectionery, as a substitute for turmeric. All chromium salts are poisonous in a higher or lesser degree.

A chief source of chromium compounds is the natural chromic ironstone. Preparatory to further processes, this has to be powdered and sifted, and in being so dealt with throws off dust made up of small particles, which act as irritants to the mucous membrane of the respiratory passages; yet it would seem, according to Hirt's researches, not to provoke so much lung trouble as might be imagined, many workers living for a series of years without manifesting marked disorder. Nevertheless, the dust, by its action upon the mucous membrane of the nose, sets up ulceration, and usually, also, perforation of the septum, but without pain or destruction of the sense of smell.

An occurrence of precisely the same character has been already noticed among cement-workers, and this fact casts

doubt upon the belief that chrome dust exerts a specific effect in inducing the lesion.

Again, in making chromate of potash, minute portions of the salt are carried into the nostrils, where they cause ulceration of the mucous membrane, just as does the dust. But this indicates no specific action, and is no more than what is to be expected from an escharotic salt, which, if carelessly handled, produces pustules and deep ulcers of the skin, that leave permanent scars.

M. Hillairet, who made, together with M. Delpech, a special study of this salt, was of opinion that its action is not confined to the nasal, but extends likewise to the bronchial passages, causing bronchitis, together with general febrile disturbance, headache, wasting, and severe ulcers about the fauces, simulating syphilitic disease. How far these various ills are due to the chromate alone may be questioned, for in the preparation of the salt the workmen are exposed to other emanations from the calcined mass when mixed with nitrate of potash;—of such is hyponitrous acid.

The morbid results of the chromate rapidly develop, attacking workmen within a few days of their entering upon their employment. Even animals living within a factory fall victims to the effects of the compound.

The bi-chromate of potash is prepared from the neutral chromate in a state of solution by acidulating it with nitric acid. The bi-chromate subsides, being only slightly soluble. Its injurious properties appear to be even more intense than those of the neutral salt. The latter forms the basis for making the chromates of lead and of lime.

The first effects usually felt by the workmen are itching and smarting within the nose, provoking perpetual sneezing; and after, it may be, only six or eight days, the septum nasi gets thin, and then ulcerates. The penetrating ulcers on the skin show for a while considerable induration, and, after they heal, indelible scars remain. Men who take snuff best escape the ills of the trade, and the subacetate of lead in solution is an excellent outward application for treating the cutaneous eruptions.

Weavers using thread dyed yellow have been found to suffer with plumbism,—an accident, doubtless, attributable

to the chromate of lead, and to the bad habit they have of sucking the end of the thread in drawing it through the eye of the shuttle.

GROUP III.

OCCUPATIONS INJURIOUS TO HEALTH BY THE GENERATION OF NOXIOUS VAPOURS.

(I.) *Poisonous or Noxious Vapours or Gases;*
(II.) *Vapours of inert character, but conjoined with heat.*

SECTION I.—The occupations which generate vapours and gases are extremely numerous,—in fact, comparatively little less numerous than the several distinct employments recognised in the trading and manufacturing world. It, therefore, is practically impossible to enumerate all such occupations; nor is it necessary, because many acknowledge to a common cause, and, besides that, the consideration already given to many manufacturing processes, has almost unavoidably brought under notice the fumes and gases inseparable from them; as, for instance, in the case of mercury, arsenic, zinc, and copper.

Moreover, it happens, with regard to many of them, that, if they be offensive, their consequences to health are by no means proportionate to the annoyance suffered. It is true that those consequences cannot be always estimated, seeing that they are, to a great extent, indirectly and slowly developed; and, moreover, are so intermingled with other insanitary influences that it is not possible to discover in what precise proportion they contribute to the evils traceable to the assemblage of factors of ill-health existing.

Another disturbing feature opposing an exact valuation of their effects upon the human system, is the existence of peculiar susceptibility on the part of some individuals to their action,—in a word, of idiosyncracy; and, on the other hand, of an indifference or insusceptibility to them on the part of others, and especially of those constantly exposed to their operation. This indifference to their agency engendered by employment is likewise exhibited, to a lesser degree, by the circumstance of proximity to their source, by the absence

of a less cultivated sensitiveness to external impressions, and by the imperious dictates of poverty, with its accompanying depressing effects upon human feelings and sensibility. And we may go a step further and say that there is a mutual action and reaction between the effects of these fumes of manufactures and the physical and moral well-being of those exposed to them. For if, on the one hand, poverty and helplessness induce indifference to them, they, on the other, have a tendency to promote the growth of poverty and misery; forasmuch as they are causes of depression alike to the physical and the moral nature of man,—causes of retrogression and of racial degeneration when acting through long periods.

A considerable number of effluvia in trades originate in what Sir J. Simon would call 'filth,' or the putrescence of organic matter, animal and vegetable, and which, to no small extent, is remediable by sanitary expedients. The direct results of such exhalations are not specifically determinable, but they make themselves cognisable by a depraved and enfeebled state of health, and probably, also, by affording morbific agents scope for wider and more serious activity.

To facilitate the examination of the poisonous gases and vapours of occupations, we shall deal with them in four sections, according as they arise from animal, or vegetable, or mineral matters, or from a mixture of these three. Their classification under the three first heads cannot be precise, because in numerous businesses the materials used are derived from two, or even all three kingdoms of nature. The fourth division established for noxious vapours is represented by those originating from dust heaps and sewage, and includes what are called the mephitic gases of burial grounds, and other places where decomposition of organic compounds is in progress. Regarded in connection with occupations, their position is not important,—though with regard to general sanitation they hold a prominent place.

The subject matter at large of this chapter has been so exhaustively dealt with by Dr. E. Ballard in his special essays on 'Effluvium Nuisances,' printed in the sixth, seventh, and eighth *Reports of the Local Government Board* for 1877,

1878, and 1879, that the material he has supplied for elucidating the effects of such nuisances upon health, must form the groundwork of any future account of them. Armed as he was with official position and authority, enjoying ample time for following up his inquiries, and possessed of long and wide experience in sanitary matters, his advantages far surpassed those of any private investigator, and his record of facts, as well as his inferences therefrom, necessarily command the highest respect. Nevertheless a lasting acceptance of his account is barred by the fact of the perpetual changes going forward in manufacturing processes, which eventually must of course render it more or less out of date. However, I consider it both a duty and a privilege to employ his descriptions and conclusions, in an abridged form, wherever available, while adding what observations I have made for myself, as likewise those recorded by other writers. At the same time, I would add, the scope of this treatise will not admit of quoting the detailed descriptions of machinery and mechanical arrangements his mission required him to give, in order to indicate defects and their remedies.

There is one initial fact concerning the outspread of effluvia that deserves mentioning, viz.:—that, as a general rule, those noxious fumes are less evident within the area of the manufactories where they originate, than on the outside, and often at some distance from them. The larger number of such manufactories consist of buildings, many of them little more than covered sheds, spread over a considerable space, and therefore affording free range to currents of air, which themselves gain in force by the rarefaction brought about by furnaces and boilers within their area. Consequently, the steam and vapours which rise from the factory itself get diffused in the air above and beyond it. Moreover, those factories are furnished by chimneys often of considerable height and great suction power, and the endeavour is almost always made to conduct the vapours into them, to compass their partial destruction in the furnace, and to secure their diffusion in space, along with smoke, at a great elevation. We can, therefore, well understand why residents at a greater or less distance from manufactories are more incommoded than those employed within them.

A. *Of Vapours or Gases of Animal Origin.*—Several of these have been noted in the account of the manufacture of wool and of hair, and in connection with the development of dust. But to these manufactures a long list drawn up by Dr. Ballard is to be appended. They are, the effluvia from keeping cattle in confinement, and from the circumstances under which they are slaughtered; those from the curing of bacon, the curing and frying of fish; from the work of fell-mongers, leather-dressers, parchment-makers, and tanners; from the manufacture of glue and size, and of prussiate of potash; from the boiling and extraction of material for glue, and of oil and fat; the manufacture of fish liver-oil, from fat melting, candle and soap-making; from the manufacture of articles from blood; from gut-scraping, gut-spinning, and the preparation of sausage skins; from bone-boiling and size-making; from the manufacture of animal charcoal and sulphate of ammonia from bones; from the re-burning of animal charcoal, and from the manufacture of artificial manures.

Those employed in one or other of these trades are sufferers, in some, though at no time, a very high degree, from the noxious or offensive emanations given off, which fall within the category of morbid agents derived from 'filth,' and concerned in the production and dissemination of filth-made diseases, so admirably discoursed upon by Sir John Simon (vide *Public Health Reports* by Sir John Simon, C.B. F.R.S., etc., London 1887, vol. ii. p. 455). The deductions and reflections made on this whole subject of vapours of organic origin, and the particular details supplied by Dr. Ballard, leave nothing to be added by other authors. To summarise Dr. Ballard's general conclusions on this whole question, they are of a negative character with respect to any one occupation he examined. He is unable to identify any special unhealthiness attributable to the foul smells, and can quote no other disturbances of health than loss of appetite, nausea, and sometimes headache and giddiness among persons residing near an offensive factory, and who have not become inured to them. If, however, no direct morbid result be proved, there is abundant evidence, as before remarked, that these offensive effluvia deteriorate the general health of those exposed to them,

favour the spreading, and furnish a nidus for the development of contagious maladies.

The occupations most objectionable by reason of their offensive effluvia, were, in Dr. Ballard's experience, those concerned in making fish-liver oil, in gut-scraping and gut-spinning, and in the manufacture of artificial manures. Of these generally, it may be stated, that the nuisances therefrom are immensely aggravated by the neglect of means to ensure all possible cleanliness, by the stolid indifference of the employed to everything sanitary in and around them, and by the faulty construction of shops and apparatus in which the operations are carried on. As to their effects on the health of those occupied, none of an invariable character can be predicated. After a while the labourers get so accustomed to the foul odours of their work that they cease to notice them, and exhibit no signs of ill-health. On the other hand, a stranger experiences at once great distress and loathing, with nausea and sickness. The effects on the alimentary canal differ in different individuals; at one time purging is set up, at another some febrile reaction with constipation.

If an inquiry were made at the present day, the investigator would find a great amelioration in the circumstances of manufactures generating obnoxious effluvia; and this better state of things must in some measure be credited to the inquiries and reports made by Dr. Ballard, at the desire of Sir J. Simon, to the attention thereby aroused, and to the admirable suggestions made for improved modes of work, and for better arrangements of buildings.

For instance, I can bear witness to the almost complete abatement of nuisances from bone-boiling, carried on for the purpose of extracting the gelatine for glue and size, for procuring the fatty and oily matters for the soap-makers and others, and for preparing the bones for calcination for the use of potters. Even immediately above the large vats filled with boiling fat, I have scarcely perceived any odour in a well-arranged factory of ample dimensions, and furnished with appliances for conveying the fumes to furnaces, and for obtaining a free circulation of air.

Moreover, what may be done in the way of abatement is well illustrated in regard to glue-works, by some excellent photographs attached to Dr. Ballard's verbal description.

With respect to soap-making, it may in passing be noticed that soap is not unfrequently coloured by poisonous materials, such as the chromate of lead, which gives it a yellow tint. So in candle-making, the fatty matter is submitted to the like proceeding, and at times bleached with bi-chromate of potash, or with peroxide of manganese and sulphuric acid.

§ 1. *The Manufacture of Leather* deserves some special notice. Its entire health aspects are not confined to the effluvia that accompany it. In the first place, most of the departments involve strong physical exertion, and require labourers of good physique. In the next place, some of the processes expose the men to steam, whilst most of them involve much wetting with water. In the third place, in handling the skins imported from abroad, there is a possibility of the inhalation of dust, which in skins from India and China contains a varying proportion of arsenic, applied to preserve them from decomposition. A further risk besides arises from skins impregnated with germs of anthrax. Lastly, in the finishing department, where leather is dressed, the men work in hot, and sometimes close and small shops.

The recognised divisions of the labour required to produce leather, are—the business of the fellmonger who receives and prepares the skins for the operations of the tanner, from whose hands they finally pass to the curriers.

The fellmonger is essentially the cleanser of the hides, ridding them of adherent dirt, hair, and wool; washing them thoroughly, and treating them with lime in tanks. The lifting or 'hauling' to turn over and spread out the hides, and to transfer them from one pit or tank to another, in the operations of liming, of washing out the lime, and afterwards of tanning, is very heavy business, and withal a very wet one.

Another laborious operation is that of cleaning off all the fleshy and fatty matters from the inside of the skin, and termed 'fleshing.' This is done on a shield-shape, rather convex, metal plate, placed in front of the worker, who uses a long knife, having a handle at each end, and with considerable effort thrusts it from him, shaving the surface clean. This work requires incessant alternate bending for-

ward and straightening of the head and trunk, and strikes the beholder as a very painful proceeding. Fortunately, the men appear to suffer no ill consequences from it after long use. At first it causes headache and vertigo.

After both sides of a skin or 'pelt' have been duly denuded by the action of lime and scraping, it is ready for the tanner, who proceeds to place it in a pit containing a tanning fluid, and after a length of time to transfer it to another and another, each containing tanning material of a certain strength and quality. The sojourn of the skins in the tan-pits is a very long one, lasting the greater part of a year. Whilst in the tan-pits they grow in thickness, for on their arrival at them they are reduced to a state of great tenuity by the shaving and scraping processes they have passed through. Every day a skin requires turning in the pit. When the tanning is complete the hides are hung up in roomy lofts, through which the outer air freely passes.

The tanning materials are not injurious. The principal used are oak bark, the cupules of some oaks from Singapore, very rich in tannin, sumach, and catechu or gambier. When duly dried the hides are complete as leather, and ready to pass to the curriers. These artisans produce the so-called 'grain' by a simple process of friction; and the black surface by rubbing in a mixture of lamp black and oil, with some size. Other colours are obtained at times from less harmless materials.

A certain measure of faint fetor emanates from the untanned skins, but no evidence is forthcoming to show it to be injurious to health. Doubtless an ill-built and ill-kept tannery might develop some injurious results; but, on the other hand, there is a popular notion that the air of tanneries is useful to sufferers with hooping-cough, and a current tradition that those who work in them escape epidemic diseases. The smell of tan predominates, but cannot be said to be either nauseous or injurious to health.

§ 2. *The Air of Hospital Wards and of Dissecting-rooms* is charged with mephitic gases of animal origin which exercise a very distinct influence upon the health of those who respire it at all continuously. It shows itself especially by

the production of a low kind of inflammatory sore throat, known as hospital sore throat, having a tendency to run on to patchy ulceration, and attended by great prostration, and mostly by diarrhœa.

The air of dissecting-rooms is to the uninitiated sickening; but among those habituated it provokes appetite, probably what should be esteemed a morbid appetite. This stage, however, passes by if anatomical work be too perseveringly prosecuted, and then arise symptoms indicative of mephitic or blood-poisoning.

B. *Of Vapours and Gases of Vegetable Origin.*—The trade effluvium nuisances enumerated by Dr. Ballard are (*op. cit.* p. 814): 'Retting of flax, distillation of wood, manufacture of oxalic acid, manufacture of paper, malt and chicory roasting, india-rubber and artificial india-rubber manufacture, bleaching of palm oil, oil-boiling, manufacture of oil varnishes, manufacture of leather cloth, of enamelled table-covers, and the enamelling of leather, paste-board, etc.; manufacture of floorcloth and linoleum, recovery of oil from oily cloths, shoddy, etc.; recovery of grease from soap-suds, and the distillation of palm oil, cotton oil, foots, and other kinds of grease.' To these may be added the bleaching of hops, of articles made of straw and of textile tissues, by sulphurous acid; the wool recovery process from mixed fabrics of wool and cotton, the making of charcoal, the preliminary washings of wool and waste silk and silk winding.

Of the exhalations of most of the industrial processes comprised in this supplementary list, and of their effects I have already spoken; whilst others mentioned by Dr. Ballard have been more or less fully examined elsewhere in connection with other factors of disease, such as dust. These remarks apply especially to the health conditions of flax-retting and of paper-making, I shall therefore not again refer to these trades, except to make some remarks on the use of esparto grass in the last-named manufacture.

The Distillation of Wood is, as Dr. Ballard observes, 'a chemical process, having for its object mainly the obtaining

of the production of a charcoal suitable for some particular purpose, such as the manufacture of bi-sulphide of carbon, or the obtaining one or more of the volatile products, or the obtaining, in a useful form, of all the substances or matters to which the process gives rise.' The essential operation is that of distilling from a retort and condensing the volatile products in a receiver, and afterwards subjecting them to whatever chemical process may be required. Whatever obnoxious fumes originate may be set down to defective vessels, or to accidental escape, and all that can be asserted concerning them is, that they are disagreeable, and travel a long distance through the air, and may induce functional disturbance among persons unused to them.

The Manufacture of Oxalic Acid is one of very limited extent. In the first instance the sawdust is mixed with an alkali, and subsequently boiled with lime, and the decomposition of the oxalate thus formed is next decomposed by sulphuric acid. The final operation is the bleaching of the product by nitric acid, which evolves nitrous fumes. The work is conducted in semi-circular iron pans heated beneath, and furnished with covers. In the course of the proceedings, and from defects in the covers, both offensive smells and corrosive fumes are apt to be emitted, which have proved active causes of irritation of the eyes and of the skin in the case of people resident outside the works.

Esparto Grass as used in paper-making.—The preparation of this substance for its purpose is attended by most offensive effluvia. The first operation is prolonged boiling of the grass with caustic soda, and afterwards with fresh water. This completed, the after processes deal with it mechanically as a fibrous material. The nuisance attending its employment is really due to a collateral process, viz.:—that carried on to recover the soda from the liquid in which the esparto has been boiled. This operation consists in evaporating the water and calcining the residuum; hence the noisome fumes given off, and for the prevention of which many ingenious mechanical devices have been invented. A like recovery process is resorted to after the boiling of wood when this substance is used for making paper.

Malt Roasting and Chicory Roasting are most simple operations, requiring no description for realising the mode and character of the annoyances they produce, and which when summed up are irritation of the eyes and throat, with some cough, and, in some people, headache.

The Bleaching of Palm Oil is effected by nascent chromic acid, developed from bi-chromate of potash by acid,—sulphuric or hydrochloric, or by blowing air through the heated oil placed in leaden tanks, or else by simple heating within a close iron cyclinder. The two last processes give rise to offensive vapours. Moreover, the storages of the rancid oil as imported in leaden tanks, is, in Dr. Ballard's opinion, attended by the dissolution of some lead. The active agent producing the irritating fumes in this and similar processes connected with the boiling of oils and fats, this physician calls 'acrolein.' It has 'its origin in the decomposition of glycerine (the base of the fatty oils and tallows) and may be obtained by its distillation.'

The same substance, acrolein, figures as the source of nuisance in *varnish-making* in the manufacture of *leather cloth*, of *enamelled table-covers*, and of enamelled leather and pasteboard, etc., for which a varnish is used having an oily basis, usually linseed oil, and variously coloured, and mixed with some mineral material, such as carbonate or oxide of lead.

The Manufacture of Floorcloth and of Linoleum.—This is a manufacture of considerable importance both in its commercial and in its health aspects. The offensive vapour thrown off is the self-same acrolein just noticed. It proceeds from the unboiled linseed oil when the floorcloth is hung up to dry in large, and usually heated, rooms. Likewise in the more complex operations to make linoleum the like troublesome vapour arises from the same substance. In this case it is used profusely to saturate the sheets of cotton or linen cloth which forms the groundwork of the linoleum.

But as well in linoleum-making as in the manufacture of floorcloth, lead constitutes the more important health factor. The basis of floorcloth is canvas of various degrees of fineness.

This is extended upon a framework of wood, and, in the first place, is sized on both sides, and then when dried rubbed smooth with pumice-stone. The next operation is to cover it with the enamel-like paint. It is thus carried out, to borrow Dr. Ballard's description:—'Paint made of about the consistence of treacle, or rather thicker, is then laid on with a trowel, and well rubbed in on both sides; and when this is dry the operation is repeated, the surface on each occasion being previously smoothed with pumice-stone. The last coat laid upon the surface of the cloth is smoothed down with a brush. The paint used is made with unboiled linseed-oil, with which dryers, such as litharge or acetate of lead, are mixed; a little boiled oil only is added. In the intervals between each coat of paint that is given it, the cloth is transferred from the painting room to a drying room. When the painted cloth has acquired, in this way, the proper thickness, it is transferred to the printing room, where the pattern it has to receive is printed on by means of blocks of wood, after which it is hung up to dry and become "seasoned." In works where strips of canvas are made into stair-cloth, the paint is now commonly laid on by a machine, which lays it on evenly.'

In making linoleum there is a jute foundation, 'which is impregnated and thickened with a mixture of boiled oil, ground and sifted cork, and colouring matter.' The linseed oil is boiled with acetate of lead as a dryer, and in due course is poured down upon the fabric so as to flood it thoroughly on both sides. It finally receives a coat of paint on one side, and is then dried and decorated by block-printing.

In the heated drying chambers the temperature will at times be raised to 180°, with a consequent greater development of acrolein and the generation of some acetic and formic acids.

The Recovery of Grease and Oil from waste or discarded material is a proceeding partly dictated by consideration of economy and partly forced upon manufacturers by sanitary authorities, to rescue streams from pollution. Even when the latter influence has prompted the attempt, it has usually been rewarded by bringing advantages and gain to factory occupiers.

It has been found profitable to recover the oil contained in the waste shoddy of cloth works, and the grease from the floors of fat-melting works; whilst the nuisance long complained of, of turning the soapy fluids or suds from woollen works into the nearest water-course, has been to a great extent removed by a process of separating the grease from the liquid mixed with it.

To take the latter proceeding first. The separation of the grease from the soap dissolved in the suds is done by sulphuric acid, which unites with the soda of the soap and leaves the fatty matter to rise to the surface, whence it is easily skimmed off. This operation is called 'breaking' the sud. It is followed by processes to remove dirt; the chief of which consists in placing it 'in an iron press enclosed in a box, into which steam is thrown at ordinary pressure.' The principal nuisance arises from the suds when kept too long; when putrefaction is set up and sulphuretted hydrogen emitted. Another minor consequence is the escape of steam from the hot presses.

To recover the oil from shoddy waste and from miscellaneous greasy mixtures, the most approved agent is bi-sulphide of carbon, which quickly dissolves oily matters. The drawbacks to its employment are its cost, and the serious effects of its vapour upon human beings. The latter circumstance will come before us when treating of the india-rubber manufacture.

The Distillation of Palm Oil, Cotton Oil Foots, and other kinds of Grease.—As the nature of his inquiry compelled, Dr. Ballard carefully described the several methods of distillation, but it is beyond the scope we have in view to enter into so much detail. We therefore confine ourselves to indicate the sources of the effluvia arising from those operations. These are found (1) in the melting out of the palm oil or grease from the casks 'by means of steam; (2) in the vapours of acrolein and sulphurous acid and other offensive vapours which are generated during the acidifying and boiling processes, and during the process of distillation, and which pass away from the acidifying vessels and from the condenser; (3) the running of the tarry or pitchy matters out of the

stills, these matters emitting, when hot, a similar offensive smell to that which issues from the condenser in the last stages of the distillation; (4) leakages in the plant' (Ballard, p. 136).

The India-rubber Manufacture is included in Dr. Ballard's list of trades setting free offensive vapours. The vapours he enumerates are: the steam given off during the preliminary boiling of the rubber; naphtha used in several processes; the steam discharged from the vulcanisers after vulcanisation is complete, and from the drying of the vulcanised rubber-sheets upon the steam-chest, after being washed.

Sulphide of Carbon.—But there is one vapour which exercises a far more serious action upon health than the odour of caoutchouc, or of naphtha,—viz., the bi-sulphide of carbon, used chiefly in vulcanising. Its phenomena were first elucidated by M. Delpech (*Nouvelles récherches sur l'intoxication spéciale que détermine le sulfure de carbone, Annales d'Hygiène publique*, 2e séries, tome xix. p. 65, Paris, 1863). Many subsequent writers have examined them, but have added to and altered little the account M. Delpech first gave. This physician found ample material for his researches in the many small india-rubber works which then abounded in Paris, and of which the insanitary conditions gave full scope to the diffusion of the poisonous vapour and to the development of its injurious effects upon the work-people. At the present day the business in England is, for the most part, conducted in large factories providing more ample space and ventilation. Moreover, many advances have been made in the arrangements for applying the sulphide; and, what is more, its employment has been curtailed by the adoption of mechanical contrivances, and of other processes, to deal with the rubber. However, a brief *résumé* of the consequences to health among those using it is desirable. The purpose of the carbon bi-sulphide is to permeate and soften the rubber, and thereby facilitate the penetration of the sulphur, or the carrying out of the so-called vulcanisation. To assist the process, a little chloride of sulphur is mixed with the bi-sulphide. In this operation the workmen both

inhale the vapour and have their hands exposed to the mixture. It is fortunate that, owing to its density, the vapour tends to sink to the floor. The chloride of sulphur adds greatly to the offensiveness of the fumes, but, in M. Delpech's belief, is not the cause of the evils experienced, which are solely due to the carbon compound. The mixing of these substances formerly was done by hand, and necessarily involved long exposure to the vapour emitted and prolonged contact with the injurious material. Mechanical contrivances have now done away with this very unhealthy manipulation.

The sulphur employed is frequently mixed with some colouring material; for instance, lamp-black, oxide of zinc, or the orange-coloured sulphide of mercury (vermilion), and probably, at times, lead salts. When a water-proof textile article is required, the vulcanising material is incorporated by rolling between hot rollers; or, otherwise, the rubber is dissolved in naphtha to form a paste, which is spread over the tissue by a 'spreading machine,' and the vulcanisation carried out in a special apparatus, which prevents diffusion of the poisonous vapour.

An excellent account of the morbid phenomena caused by the inhalation of bi-sulphide of carbon is given by Dr. Gallard, Physician of the Hospital 'La Pitié' at Paris, in his *Clinique Médicale* (Paris, 1877). He recognised two distinct stages:—(1) of excitation, and (2) of collapse or depression, resembling in all particulars, except duration, those met with when anæsthetics are administered, and also those due to alcohol, especially the chronic effects of the latter. The onset of the illness is at times sudden, but usually is delayed for several months. Persistent headache is a primary symptom, and most felt after work is over. It may be partial or general, and is, ere long, accompanied by faintness, vertigo, cramps, and even epileptiform seizures. Then follow muscular pains and tremor, with great debility. The mind becomes excited; the patient gets loquacious and excessively active, or, in some few instances, sad and moping, very irritable and sleepless, and easily aroused to acts of violence. There is a strong sexual excitement, accompanied in females by menorrhagia and, among those pregnant, by miscarriage.

The period of collapse, on the contrary, is marked by depression, and ofttimes enfeeblement of mind; by indifference to objects, and by weakened memory and power of expression. Cephalalgia persists, and in place of exalted sensibility there are anæsthesia and analgesia, imperfect vision, and amaurosis. Deafness may also occur. The previous sexual excitement is succeeded by extinction of feeling, and in youths by atrophy of the testes. Among women, sterility is a result. Other phenomena are muscular feebleness and rigidity with paresis, mostly on one side, diminished sensibility to cold, and at times muscular tremor.

The sequence of the two stages is rapid, and not always discernible; an appreciable interval, however, may show itself between them.

The condition set up has to be diagnosed from general paralysis of the insane; from acute mania, and, above all, from alcoholism.

Dr. Ross, of Manchester, contributed to *The Medical Chronicle* for 1886-87 two interesting cases of poisoning by the sulphide of carbon. In these examples paralysis existed analogous in form to that induced by various toxic agents, as alcohol, lead, arsenic, and certain animal poisons, such as that of diphtheria. Pathologically, he considered it to be due to the form of peripheral neuritis described as progressive multiple neuritis, or polyneuritis multiplex.

It is marked by absence of patellar tendon reaction, and by the gait being high-stepping, though not disorderly and thumping, like that of ataxy. It most resembles alcoholic paralysis, but the affected muscles are not hyperæsthetic as they are in the latter. On the other hand, amblyopia and loss of colour vision occur in it, but not in alcoholic paralysis.

The production of amblyopia has been noted by Mr. Nettleship and by M. Fuchs, as stated in the *Transactions of the Ophthalmological Society* for 1885, also in *Lancet* for October 1884. There is chronic optic neuritis. Cessation from the work will usually soon restore the sufferers; commonly, when better, they will resume the occupation, and eventually fall into a chronic state; become depressed, apathetic, feeble in limbs, if not paretic; weak in mind, and wasted in body. As happens with other poisons, the degree of suffering varies

according to the constitution, sex, and the susceptibility or idiosyncracy of individuals. Fuchs describes atrophy of the interossei muscles of the fingers and thumbs, and it is reported that more injury follows where the 'Parkes' process is pursued.

Sulphide of Carbon is employed in other operations, in various degrees of purity. Thus Vernois (*op. cit.* vol. ii. p. 464) states that it is used in lace-making, and for the purpose of extracting the oil from oleaginous seeds, and of removing fatty matter from bones. Moreover, endeavours have been made to utilise the sulphurous acid emanating from its combustion, for the making of sulphites; it takes the place in part of ether and alcohol as a solvent of the cotton powder or pyroxyline, in the preparation of collodion; it is useful for removing oleaginous matters from wool, and in its purest form, but much diluted, fixes the volatile oils of pepper and pimento. We have, however, no evidence that, in these varied applications, it has produced obvious bodily disorder, though it is, at the same time, conceivable that its vapour will always produce some effect, if only a slight and transitory one.

Naphtha.—A much more generally diffused vapour throughout a rubber factory than that of bi-sulphide of carbon, is naphtha. This is the special solvent employed for the rubber, and enters into several processes; more particularly where the material is to be formed into sheets. It is, likewise, the solvent used in making the adhesive fluid for uniting the edges of manufactured waterproof articles where sewing is not practicable. It has a somewhat intoxicating effect upon those who inhale it and are not accustomed to it, and will cause headache and giddiness, with languor and a feeling of general malaise. Diarrhœa and loss of appetite are occasional consequences, and also nervous excitement, sufficient to disable female workers from following their employment.

There are other incidents belonging to the manufacture under notice. Owing to the adhesive tendency of india-rubber, the powder of chalk, or French chalk, is applied to obviate it, and consequently a certain amount of dust inhala-

tion attends this proceeding. The same thing happens in vulcanising the sheets of rubber, by rolling in, under great pressure aided by heat, sifted sulphur, and when colour is wanted, lamp-black, oxide of zinc, or the orange sulphide of antimony. Sometimes the more objectionable salts of lead, *e.g.* litharge, are used for a similar purpose; carbonate of lead also forms part of the enamelling substance used to coat over capes and aprons for coachmen and carriages, and other glazed articles, to render them impervious to water.

Besides its use in rubber factories as a powder, sulphur is likewise employed in a fluid state; as when it is required to sulphurise rubber tubes, by their immersion for a short time in sulphur vats, from which a distinct sulphurous fume escapes.

In vulcanising a piece of linen cloth, the rubber dissolved in naphtha is first spread by hot cylinders over its surface, and thereupon sulphurised by being passed through a chamber containing a complicated system of pipes, whereby it is brought into intimate contact with sulphur at a temperature of 260°. The room in which this operation goes forward is hot, laden with much steam and some sulphur vapour. Very few are employed in it, but these complain of sore eyes and slight feeling of throat irritation.

India-rubber manufactories exemplify a fact heretofore insisted on; viz., the great variety of operations carried on within a factory. Here the operatives themselves are popularly spoken of as india-rubber workers, although they have little in common beyond working on the same premises. Thus we have strong mechanical labour in connection with the powerful engines which flatten out the crude rubber submitted to them; in other departments, dust; in others, steam and the vapours of sulphur and bi-sulphide of carbon, and in the finishing rooms, nothing else save a pervading vapour of naphtha, along with sedentary employment.

In the department last named, the employed are almost all females, and engaged in making up the 'Macintosh' cloth into articles for dress, and for numerous other purposes; as, for example, toy whistles and balloons, nipples for feeding-bottles, and fine tubing. Others are occupied in packing the smallware in cardboard boxes, and generally in those final

manipulations required to place the products of the factory in the market to the best advantage.

Vapours arising from other manufacturing processes in which vegetable matter is concerned, are found in distilling, brewing, and vinegar-making. In all these the carbonic acid gas evolved is the principal agent of mischief. It abounds in several departments of those businesses, but its effects are taken no account of, unless by accident a workman becomes overpowered by the gas in cleaning a vat, or on entering some confined space where it has accumulated during the process of fermentation.

A nuisance also arises when spent hops or grains are allowed to accumulate and set up fermentative action; but there is no evidence of any illness traceable to it. The waste of distilleries has been written about as a cause of illness; but where this has happened, it may be set down to neglect of ordinary sanitary rules.

C. *Noxious Vapours of Inorganic or Mineral Origin.*—The number of such vapours is almost co-extensive with chemical processes, and as it is impossible to examine them in detail I shall attempt only a selection.

The Burning or Firing of Clay goes forward in brick and tile-making, in cement-making, in ballast-burning, and in the manufacture of stoneware, common redware, earthenware, and china; and, excepting in the two last-named businesses, is a direct source of contamination of the atmosphere. In the making of earthenware and china, it has been seen that the ware is enclosed in covered and luted boxes called 'saggars,' and this being so, no pollution of the air can arise from the firing of the ware itself. What nuisance arises comes from the smoke of the coal consumed in heating the furnaces, which, though given off in very large quantity, is rather an annoyance than a cause of disease.

But where crude clay is burnt in conjunction with coal, the smoke from the latter is intermixed with vapour and various gases from the clay, and proves not only annoying but also an irritant to the mucous membrane of the respira-

tory tract, to the conjunctiva, and to the nasal cavities, throat, and bronchi, and hence causes a suffocating sensation.

The amount of irritating smoke and vapour differs materially according to the mode of firing adopted, whether on an open space, or within kilns or ovens; to the rapidity of combustion; to the quality of the clay and of the other mineral matters mixed with it, and to the quality and composition of the coal or other fuel used.

Clays differ widely among themselves, according to their stratigraphical position and mineralogical characters. Thus they are at one time mingled largely with chalk, at another with sand, at another with shales; whilst some are taken from the beds of old lakes or streams, and are replete with organic remains, and often with salt. Again, they are designedly mixed with sand, chalk, ashes, and straw.

Brick-burning in 'clamps' in an open space, as seen chiefly in the south of England, is productive of much evil-smelling vapour and smoke, which has proved poisonous to individuals who have remained in near contact with it. The same holds good concerning the burning of clay for 'ballast' to serve as a substitute for gravel, as commonly seen where railway lines and new carriage roads are being laid out. Both in 'clamp' and in 'ballast' burning combustion is slow, and the volatile products thrown off are accompanied by more vapour, and are less oxidised than those emanating from a kiln where a bright red or nearly white heat is in action.

Where bricks and tiles are fired in close kilns, less annoyance happens. A very dense pungent smoke issues for a short interval, almost wholly derived from the coal thrown into the several open-mouthed furnaces built around the kiln, within which the bricks or tiles are skilfully placed, to allow of free passage for the heat and flame.

It is mainly to sulphur-acids that the pungency and acidity of the smoke in clay-burning is due, whilst its offensiveness is augmented by some sulphuretted hydrogen. The proportion of these acids will greatly depend on the composition of the fuel used, and in a less degree upon the chemical nature of the clay. Where clays are rich in salt, hydrochloric acid is thrown off; in like manner, those that abound in shales are productive of acid sulphurous fumes.

Cement-making has been examined in its relation to dust inhalation in a previous page; but as it is a business against which numerous complaints have been lodged on account of the noxious fumes attending it, some further observations upon it are desirable.

As before stated, Portland cement is made from alluvial clays and river mud mixed with chalk, which, after due grinding with water, are placed in kilns, from whence principally the offensive vapours escape. As Dr. Ballard points out, the nuisance is greater where the clays and mud are richer in organic matters; but he evidently regards it as but little worse than that of burning bricks in 'clamps.'

The fumes travel far and wide from the summit of the tall chimneys provided, to the greater discomfort of persons resident at a considerable distance than to those in the vicinity of the works. 'The offensive smell is most marked at the time when the charge approaches its greatest heat. Towards the end of the process the vapours emitted lose their offensiveness. The offensive vapour which escapes from the kilns after the escape of watery vapour is white, and deposits a crystalline matter,' about any apertures. This, on analysis, proves to consist chiefly of the sulphate of lime and potash, with a small proportion of their chlorides. The vapour itself gives evidence of the presence of sulphurous acid and of sulphuretted hydrogen, whilst the air for some distance around the kilns contains an excess of carbonic acid. Dr. Dupré, from a special analysis of the gases taken from the interior of the kilns, established the occurrence also of carbonic oxide, oxygen, nitrogen, and ammonia, and traces of cyanides. However, it must not be concluded that the very same gases escape from all cement works alike.

The accounts of the effects of the fumes of cement-making on health are somewhat divergent, proceeding as they do from different places, in respect of which uniformity in the composition and making of cement cannot be predicated. The most common complaints made are, headache, loss of appetite, disagreeable taste, and parching of the mouth and throat, nausea, vomiting, oppression of breathing with a sense of constriction of the chest. A medical man practising near some large cement works, expressed it as his conviction that

the fumes had a deteriorating effect upon the general health and appearance of the population; those most exposed to them becoming pale and sallow. Also, that when disease attacked persons, it assumed a lower type. With reference to remarks of this sort, I would observe that they must be received with caution; so many are the accidental circumstances, both within and without manufacturing premises, calculated to affect the general health and aspects of a community.

In the occupation under notice the nature of its manufacturing details, the simple unskilled labour required, and consequently the smaller remuneration afforded, are all circumstances that cause it to fall into the hands of the coarser sort of labourers, men mostly indifferent to sanitary considerations, and too often inclined to intemperance. Again, if this class of workers are so when entering upon the employment, the probability is that they will become yet more reckless of health by the reaction of the occupation upon their physical and moral nature. Like other offensive trades, this of cement-making is driven away from localities where the cultivation of the inhabitants revolts against it, with the result of detaching the labourers from humanising influences, and of branding them as individuals engaged in a degrading occupation. It is a proceeding that operates unfavourably both on the moral and physical well-being of those subjected to it, and likewise of those who may by accident be brought into close contact with them. It creates small isolated settlements of labourers who are, so to speak, under the popular ban, and who, when left to themselves, are most prone to recede more and more from civilised life and manners; and these adverse influences are in most instances strengthened by the physical state and surroundings of the localities where the tabooed business is allowed to exist.

Further, if success attend upon the manufacturing venture in its new locality, it will happen that ere long a new population will spring up, condemned to endure the ills attaching to the site, combined with whatever others belong to the manufacture. It also comes to pass that the introduction of an occupation, such as referred to in a hitherto agricultural

village or hamlet, leads to a transformation in the sanitary and moral features of the population, frequently of an undesirable character. These remarks, suggested by the history and character of cement-making, apply equally to many other noxious trades; and they further indicate how large allowance need be made for vital conditions outside the manufacture, when we seek by statistical figures for mortality and sickness to discover what are the consequences actually pertaining to a manufacture.

'*Spoil-banks*,' the name applied in mining districts to enormous accumulations from coal-mines, forges, and blast furnaces, are a source of abundant noxious vapours and gases. Those about coal-mines are made up of shaly and other waste products of the coal measures, in which iron pyrites is intermixed in small quantities, along with a certain measure of coal dust. This combination of mineral matters is liable to spontaneous combustion, from the interaction of the oxygen of the air upon them, aided by water. The same accident happens with the waste small coal, shale, and other accidental matters that get heaped together in the underground passages or roads of coal-mines. The heap of mixed materials is called a 'gob,' and the fire originating from their spontaneous combustion is known as a 'gob' fire,—an occurrence in pits containing much gas that now and then leads to an explosion.

The heaps derived from furnaces and forges are not spontaneously ignitable, but are composed mostly of slag, mixed with furnace ashes; and as the former is removed in a state of vivid red heat, although consolidated, it sets fire to any combustible material it comes into contact with, and continues to burn in a slow fashion for months together, evolving all the time suffocating fumes.

The gases thrown off are of a mixed character, consisting largely of carbonic oxide, with a variable proportion of sulphurous acid. They, consequently, are irrespirable and obnoxious to health, producing throat irritation, cough, a feeling of choking, lassitude, anorexia, and general malaise.

Now and again, about old pit workings, the waste gets on fire and burns for a distance underground; so that where

cottages have been built on pit heaps, or on greatly shaken ground near at hand, the gases of combustion make their way into their lower rooms and cellars, and drive out the tenants. Indeed, cases are on record where the presence of the poisonous gases has been unnoticed, and death by suffocation has supervened during sleep in such habitations.

Smelting and Calcining Metallic Ores is a source of very annoying and injurious vapours acting both on human beings and animals, and on vegetable productions. To enter upon the modes of smelting and of producing pure metals from their ores would carry me far beyond the limits and purpose of this treatise. What is necessary to say about the operations considered in their hygienic features may be said within a moderate compass. For it so happens that metallic ores have, for the most part, many points in common; their usual accessory ingredients are sulphur and arsenic, and both these are separable by heat, by a more or less simple process of calcination, or burning with the aid of superadded combustible material in the form of wood or coal.

Roasting or calcining ores may be done on the surface of the ground or in enclosed furnaces. Ironstone is generally calcined on the surface of the ground; but when lead, tin, and copper are smelted, roasting in furnaces,—reverbatory for the most part,—is resorted to, because of the presence in them of other metals of value, recoverable by chemical agency, or by being deposited in their passage through very long flues. This occurs pre-eminently with arsenic, and in a lesser degree with silver and lead (see p. 422 *seq.*).

Moreover, some iron pyrites contain not only sulphur in considerable quantity, but also copper in a less proportion. The sulphur is roasted out of the ore in specially constructed ovens to make sulphuric acid, whilst the ash which has delivered up its sulphur is a still valuable commodity from which copper may be extracted with profit.

Calcining the usual sulphide of iron ore on the open surface of the ground is a serious nuisance to all to whom the smoke and sulphurous, carbonic oxide, and other gases, carried by the wind, reaches. Its destructiveness to plant life is made visible, but its injurious effects upon the health

of human beings are not so obvious. Those who breathe it experience headache, a sense of choking, with dryness of the throat and irritation of the bronchial mucous membrane, and sometimes nausea from the sulphurous odour. In a concentrated state the gases would, doubtless, be fatal; but their rapid diffusion through the atmosphere robs them of this terror. The labouring classes whose cottages are near the calcining heaps are the chief sufferers, but we know of no reliable information respecting disorders attributable to the smoke, beyond those just now enumerated.

In a thickly peopled country like England this rude method of calcining iron ore is a barbarism as well as a serious annoyance, if not provable as a cause of actual disease. It is an operation that could be conducted in covered kilns or ovens, as in the case of coke-making.

Lead Smelting is conducted either in a furnace or on a 'hearth.' The ore most used is the sulphide, or galena, and the business is to remove the sulphur; this is done by heat, aided by a blast of air, which drives it off in the form of sulphurous acid, mixed with the volatile products of the fuel used, some sulphate of lead, and other matters,—including silver, arsenic, and antimony, commonly existing in galena.

This sketch is sufficient to indicate the sources of the nuisances that arises from the business; they are sulphurous and arsenious acids, and in and about the smelting shop, with fumes, and possibly atomic particles of lead, which cause plumbism among the workmen. It is the offensiveness of the sulphurous acid that is most complained of; but, probably, the headache and sickness suffered by some people who inhale the smoke from smelting works are rather attributable to the arsenical vapours it contains.

The history given of lead as a poisonous material used in manufacture will supply all other information necessary to elucidate the subject.

Tin and Copper Smelting.—The ores of tin and copper are rich in arsenic, which is extracted from them by a preliminary process of calcination. This operation, at the same

time, removes combined sulphur. The fumes arising are usually conducted, as in the case of lead-smelting, through flues of very great length, terminating in a tall chimney. In these flues the arsenic, vaporised by heat, condenses, and the greater part of the nuisance felt proceeds from sulphurous vapours, which prove destructive to vegetation within their reach. The workpeople in the calcining, or 'burning,' houses are subject to an eruption about the genitals and exposed parts of the body; still no evidence could be got by Dr. Ballard of the action of arsenic; not even where the rain water of the vicinity was drunk, though this might be expected to contain some of the poison washed out of the surrounding air.

Dr. Ballard's analysis of the records of sickness and mortality of Swansea and contiguous villages, went to show that localities most exposed to the smoke of the smelting works actually exhibited a less ratio of deaths from all causes than did Swansea itself, which suffered decidedly less from the annoyance. On the other hand, the more acute forms of pulmonary disease—croup, pneumonia, bronchitis, and pleurisy—produced a higher percentage of deaths in the smoky suburbs than in Swansea town. The smoke likewise proves a source of especial distress to persons sick with pulmonary ailments. The ratio of deaths from phthisis was about the same in each district examined. With respect to the discharge of sulphurous fumes, there is good prospect of converting what is now an especial nuisance to health and comfort into a source of profit, by utilising those vapours to make sulphuric acid.

Lime-Burning is too familiar a business to require a description. It is conducted either in close or in open kilns, and its fumes will vary in quality according to the character of the limestone and of the fuel used. Dr. Ballard found carboniferous limestone to be more offensive than other varieties. Combustion proceeds slowly, and the actual smoke given off is not considerable; but the carbonic acid and carbonic oxide combined with it, make it injurious to health, and dangerous to those who fall to sleep near limekilns. Persons exposed to them by residence suffer great prostration,

nervous debility, headache, and loss of appetite. They are both pungent and suffocating.

The Manufacture of Alkali from salt is a very important chemical industry, though, at the present day, less so than formerly, having ceased to be as remunerative on account of the invention of other methods of obtaining soda.

Owing alike to its commercial importance and the widespread injury done to vegetation in the vicinity of alkali works, it is an industry which has been copiously reported upon, and especially so by the late Dr. Angus Smith, the Chief Inspector under the Alkali Acts. The technical processes of the manufacture need not be particularised. The materials used are common salt, sulphuric acid, limestone, and coal. By the interaction of these substances, carbonate of soda and sulphide of calcium are produced in the form of 'black ash.' This resultant has to be lixiviated with water, which dissolves out the soda, and when this solution is drained off, the residue is known as 'tank-waste.'

In the course of the chemical action taking place on mixing the component materials, hydrochloric, sulphurous and carbonic acids are given off in conjunction with watery vapour. The chief components of the 'tank-waste' are—carbonate, oxide, and sulphide of lime, intermixed with some alumina, silica, and carbon.

Up to the termination of the operation of making the 'salt cake,' the processes for making alkali and of chloride of lime follow the same line. When alkali is required, the 'salt cake' is disposed in huge revolving furnaces along with chalk, and after exposure to high heat, the resultant mass, known as 'black ash,' is discharged into trucks for conveyance to tanks of water, in which the contained soda becomes dissolved. The liquor is subsequently boiled down and finally 'soda ash' is obtained. From this substance the common soda of commerce is obtainable. But, as a general thing, preference is now accorded to the ammonia-soda process for producing this substance.

When caustic soda is wanted, the alkaline liquor is boiled down in a sort of caldron or vat, and passed from one vat to another until the required density is obtained, when it is drawn off, and rapidly assumes the solid state.

It is the acid vapours, conjoined with heat, that are chiefly injurious. The damage to vegetation is obvious to every one who has visited the site of alkali works. Concerning their evil to human beings, there is considerable diversity of opinion; but it seems inconceivable that those exposed constantly to the inhalation of air loaded with acid and other noxious vapours and gases, irritating to all mucous surfaces they may reach, can enjoy that share of health that would be their lot under more favourable conditions.

Speaking of hydrochloric acid fumes, Dr. Angus Smith says, 'with 0·0031 per cent. in the air, the smell is strong; some persons become accustomed to more than this amount, but generally it is found impossible to overcome the repulsion to the smell, and the inclination to cough. It is, however, certain that some men keep excellent health, breathing quantities which are intolerable to others; and others recover their appetite only in its presence.'

A still more obnoxious gas originates from the waste heaps of alkali works; viz., sulphuretted hydrogen, mixed at times, with some sulphurous acid. This evil arises when a heap of tank waste takes fire; though, in a less degree, the gas will be also slowly given off from the action of the air and moisture. Pure sulphuretted hydrogen is highly poisonous, and puts an end to life by coma.

As before remarked, doctors differ respecting the degree in which the effluvia of alkali works affect injuriously the human system. The comparison of death-rates in alkali-making districts with those of other places, proves nothing; and whereas Dr. M'Nicoll, the Medical Officer of Health at St. Helen's, is satisfied that the vapours of that alkali-manufacturing town deteriorate the general health of its inhabitants, and produce bronchitis, asthma, and sometimes pneumonia, his colleague, Mr. Cooper, of the neighbouring town of Widnes, where like industries are carried on, has discovered no ill effects from the same vapours, not even in the intensification of maladies. The latter gentleman was, moreover, convinced that the children of this town were remarkably healthy, and contrasted favourably with those of Liverpool; and, to Dr. Ballard's mind, this assertion appeared correct. A third

practitioner, Dr. Robinson, is cited as agreeing with Mr. Cooper's views generally, though he admits that people with chronic laryngeal affections suffer from the vapours. And Dr. Ballard adds, that 'he has neither observed that the vapours injure phthisical or asthmatic people,' nor that they impart a fatal tendency to diseases in general. Lastly, Mr. Mouritz, of Runcorn, whilst concurring with the two latter medical men on the general issue, believes the vapours are prejudicial to those on the works who happen to have pulmonary disease.

Dr. Ballard seeks to reconcile, to some extent, the divergent views of Dr. M'Nicoll and Mr. Cooper, by observing that St. Helen's and Runcorn are situated on a wide tidal river (the Mersey), and, in consequence, have the advantage of rapid currents of air, and extend over a wide area; whereas Widnes is more inland, more closely built, and more surrounded by chemical works.

Further, respecting the effects of sulphuretted hydrogen emitted from the waste liquor heaps, Dr. M'Nicoll testified that the ratio of sickness is increased thereby; that infant mortality is excessively high, and that most epidemics in St. Helen's assume a malignant or typhoid type, owing to the diffusion of that gas in the atmosphere. This conclusion was favoured by the experience of Mr. Spear, formerly medical officer of health for Jarrow.

In the processes of alkali-making there is great exposure to heat and vapour, and the labour involved is of an exhausting character. Moreover, the vats or tanks of boiling soda-liquor expel with the rising steam, particles of caustic soda which injure the skin they fall upon.

One feature that strikes the ordinary visitor to most alkali works is the apparent roughness and general want of arrangement and of attention to the intersecting roads and ways in and about them, as well as to conditions for safe working and the avoidance of accidents. Speaking generally, they consist of more or less straggling shops and sheds, with bad approaches, difficult ladder-like stairs, often dilapidated, unpaved yards and passages, either very dusty or very muddy, with furnaces, caldrons, and tanks of various kinds placed here and there, and for the most part with few pro-

tective provisions against accidents. It may therefore be surmised that, what with fires, steam, acid fumes, various gases, and emanations consequent on chemical combinations, and the smoke and vapours from a multitude of chimneys, the air around and about them is far from salutary, or that accidents are numerous. Accident reports to the Factory Office tell of suffocation in cleaning boilers, of disastrous falls, of burns and scalds, of falling into pans of alkaline liquor, of gassing and other misfortunes, besides many minor mishaps, of which no account is taken.

On a review of the conditions of labour in chemical works generally, the inquirer will be impressed with the necessity for better arrangements for removing noxious fumes, for securing ventilation to disperse virulent vapours, for lessening the exposure of workmen to heat and acid and other emanations, for fencing dangerous places and lessening the use of planks as gangways. That many such reforms may be made is proved by what has been done in some factories compared with others. Lastly, humanity calls for the reduction of the hours of labour for some classes of the workmen, especially the chloride-of-lime workers and the men stoking at salt-cake furnaces.

The labour followed is almost wholly unskilled, demanding little but brute strength, endurance, and indifference to annoyances, hardships, and perils. It therefore attracts an inferior class of men, upon whom, in its turn, it can exercise no humanising influence, though it accord to them ample wages, too frequently to be turned to their own detriment. Workmen of this class bring numerous ills upon themselves by their ignorance, indifference to cleanliness and rules of health, as well as by utter carelessness in their way of work, and by needless exposure to danger. The fact is generally acknowledged that these labourers in chemical works are utterly indifferent to precautions against taking cold by passing from the locality of heated furnaces into the open air, in a more or less unclad state; and that, in consequence, they suffer more than their share from chest diseases. This indifference certainly is not peculiar to them, for the same thing is seen among the puddlers and others working in iron forges and foundries.

Just before going to press, some communications reached me written on the question of the health and mortality of labourers in chemical works; and as they come from those well qualified to express an opinion upon the subject, I will briefly resume their conclusions. They are by Dr. R. M'Nicoll, the Medical Officer of Health for St. Helen's, and his colleague, Dr. Robertson. The results spoken to are derived from life-long experience among the labourers in question. He states that they are undoubtedly more liable to bronchitis and diseases of the respiratory tract than other labourers; but he is not prepared to assign this fact solely to the one cause, irritation from gases generated, believing that their needless exposure to cold, in a half-clothed state, in passing from near heated furnaces into the open street, is in no small degree contributory to it. 'A large number of the cases of being "gassed" and of burns are due to the carelessness of the men, who forget they are dealing with materials perhaps as dangerous to life as gunpowder.'

Dr. Robertson abstracted the history of 503 labourers in reference to their mortality and causes of death. The result is thus represented:—

		Ordinary Labourer.	Chemical Labourer.
Mean age at death.	Diseases of the Lungs	49 years.	45 years.
	All other diseases	50 years.	51 years.
	Mean age at death from all causes . .	49½ years.	48 years.

'Unfortunately, these observations are made from an insufficient number of cases (503) to do more than give a general indication of the fact, that while there is a difference of one and a half year in the mean age at death from all causes, there is a difference of six years between the two classes from diseases of the lungs.'

It may be added that, as the mean age of chemical labourers is greater than that of ordinary labourers, as far as the mortality from diseases in general is concerned, we have an additional proof of the influence of occupation, on the

one hand, augmenting chest diseases; whilst, on the other, showing a less ratio for all other forms of sickness.

The Manufacture of Salt presents few conditions seriously affecting the health of those engaged in it. Those that attract attention are heat, steam, exposure to variations of temperature, and in a slight degree to sulphurous and hydrochloric acid vapours.

As commonly conducted, the making of salt is a simple process of evaporation of brine pumped up from the earth's strata, carried on in shallow large iron pans heated by fires beneath. The business of the labourers is to remove a scum that rises to the surface, to withdraw the salt when formed, and, at intervals, to break up and clear away a sedimentary matter called 'the scale,' which collects upon the bottom of the pans, and is rich in sulphate of lime.

The boiling of the brine is done in covered sheds, having spaces in the roof for the escape of steam. Nevertheless, the sheds are more or less filled with watery vapour, and grow very hot, conditions that induce the workmen to dispense with clothing beyond what decency requires. Moreover, the sensation of heat leads them to seek for cool air, and this they are apt to do recklessly, and consequently with injury to their health.

The diseases, therefore, to be looked for among these labourers are rheumatic affections and acute and chronic respiratory lesions.

Usually, for the sake of economy, the coal used in the furnaces is of inferior quality, and in the shape of 'slack,' and sold at coal-pits as fit for no other purposes. As a result, and so much the more by reason of bad stoking, a vast amount of black smoke is thrown off from the commonly low chimneys of the sheds, mixed with much sulphurous fumes and some hydrochloric acid vapour. This last is derived chiefly from the decomposition of salt which has leaked from the pans and got mixed with the fuel beneath.

Acid fumes likewise arise from the waste heaps of salt 'scale' which are allowed to accumulate about the exterior of the sheds, where they get mixed with the ash and clinkers

drawn from the furnaces. These heaps are apt to take fire from the ignited cinders thrown on them, and when they do so, they exhale a very offensive irritating vapour.

Of the smoke and mixed acid vapours escaping from the chimneys, it may be said that those living contiguous to the works suffer more than those occupied within them. The worst exhalations come from the waste heaps when on fire: and Dr. Ballard, whilst unable to discover obvious results to health from the smoke of the sheds, is satisfied that the vapours from waste heaps, 'when sufficiently abundant, and in a sufficient state of concentration, are irritating to the eyes and organs of respiration at a distance of at least 80 yards, and that they may occasion a sensation of suffocation or oppression at the chest, and cough, with general malaise, headache, and loss of appetite. Dr. Roden of Droitwich informs me that they are particularly distressing to persons who are labouring under any pulmonary affection' (*op. cit.* p. 188).

The Salt Glazing of earthenware and stoneware is carried on on the largest scale by Messrs. Doulton, of Lambeth and St. Helen's. It requires mentioning in this place, because the smoke and vapour issuing from the ovens and kilns contains a very appreciable proportion of hydrochloric acid derived from the salt. The salting has to be delayed about five days after the ware has been placed in position, and by which time the furnaces have reached a white heat. On the addition of the salt, copious white and pungent vapours escape, but soon subside; they contain hydrochloric, sulphurous, and sulphuric acids, and common salt in very minute particles.

The health defects in the trade reside in the great heat submitted to, and in the danger of inhaling the acid vapours. Actual examples of this danger, however, are not forthcoming.

Coal-Gas Manufacture.—It will not be necessary to describe in detail the process of gas-making. In general terms, it is the destructive distillation of coal in retorts, the collection, separation, and purifying the volatile products

from the solid residue in the shape of coke, and from tarry matters.

Taken as a whole, it is a manufacture which, although containing elements of danger to health and life, is practically productive of little disease. At the same time, the vapours and gases thrown off at different stages of the manufacture render gas-works a decided nuisance to any neighbourhood; and should their diffusion in the air grow excessive, life would be endangered.

The first division of the work is in the retort-house, in which the distillation is effected. The labour there exposes the men to great heat and smoke, and to more or less coal dust, as well as to the occasional escapement of impure gas. The next processes are those for separating the tar and purifying the gas by what are called scrubbers, which act mechanically and automatically. Purification is further attained by conducting the gas through oblong boxes or 'purifiers,' disposed in tiers, and filled with dry lime and oxide of iron. The lime absorbs the carbonic acid, and the sulphuretted hydrogen; and in the course of further reaction, bi-sulphide of carbon is developed, which has to be got rid of.

The dry-lime purifiers are, for the most part, in use, but wet-lime purification is occasionally carried on. The lime deposited in the latter operation is known as 'blue-billy.'

This sketch of the main features of coal gas-making will make clear the account Dr. Ballard gives of the sources of nuisance attending it. He writes (*op. cit.* p. 118) there are:—'The issue of smoke and offensive vapour from the retort-house; the process of emptying the purifiers, and the deposition of spent lime in the yard, the effluvia from the accumulation of 'blue-billy,' and the use of luting made of that material for the retort lids, the revivication of oxide, the free exposure of tar or ammoniacal liquor to the atmosphere, and lastly, the removal of the various refuse matters, such as spent lime, tar, or ammonical liquor from the premises.'

Time was when gas ammoniacal liquor, the tar, and other products, were an embarrassment to gas-makers, were accounted waste, and commonly turned into adjacent rivers. This state of things is now completely reversed, the 'waste'

products of gas-making having acquired a value almost equal to that of the purified gas itself.

Accidents by suffocation have happened in gas-works, and the retort labourers often suffer rheumatism, sciatica, and lumbago, and get husky, difficult breathing, which they designate asthma. But the general effects of the effluvia—offensive as these are to the senses—are trivial in relation to health, and seem limited to nausea, headache, and anorexia. Cutaneous eruptions occur among the stokers from heat, sweating, and coal dust. Speaking from my own inquiries, I cannot discover that those employed in gas-works are less healthy than other labourers.

Improvements in the construction of the retort-houses, in the arrangements for burning the coal, and in the methods of feeding and stoking the furnaces, have done away, in a very large measure, with the physical labour formerly required, with exposure to heat, and with the dissemination of dust. A machine now feeds the fires, and does away with the old style of shovelling the coal on them; and a modern retort-house may be entered by any one without discomfort.

Carbonic Oxide is a principal component of the smoke and vapours escaping from coke ovens, and also from charcoal burning and gas-making. It is decidedly poisonous; and in its impure state as usually met with, its choking effects give warning to those exposed to its inhalation. The commonest source of it is from the burning of coke, which is so often resorted to in many small trades where a steady heat is required close at hand. This desideratum is readily supplied by coke burnt in small portable grates or braziers, placed conveniently to hand; whilst little or no regard is taken concerning the necessity of carrying away the vapour generated. Hence those using these portable stoves get a husky throat, a sulphurous taste in the mouth, with giddiness, stupor, nausea, loss of appetite, flushing of the face, and irregular heart action.

The tradespeople most exposed to these accidents are plumbers, braziers, tinmen, and tinkers; but wherever coke is burned in rooms wanting in free ventilation, there, too, the inmates will suffer in some measure.

Dr. Richardson states that lacemakers in cold weather,

whose fingers must be kept warm to carry on their delicate work, are accustomed to 'place a chafing dish of burning coke beneath the frame, and directly under their own nostrils.' In consequence, they suffer from the carbonic oxide, and, after a while, fall into a state of low health, with dyspepsia, fetor of breath, a nervous, hysterical condition, and anæmia, with great depression of muscular power.

Another small body of artisans who breathe carbonic oxide from burning coke, are stick-makers, who char their sticks over a coke fire, and thereby obtain the rich brown-clouded colour often sought for. In this trade we have an example of the concurrence of several causes of annoyance, if not of damage, to the respiratory organs. For besides carbonic oxide from the coke, there are pungent vapours arising from the charring; and, again, a certain amount of detached carbon that may be inhaled, and set up bronchitis.

Carbonic oxide in common coal gas amounts to only four or five per cent., whereas in so-called 'water gas' it constitutes one-third, or even more. The other chief ingredient of the latter is hydrogen. It is the presence of the carbonic oxide that lends the great fatality to water gas, which sad experience has shown to happen where it has been in use as an illuminant. Its danger is, unfortunately, greatly favoured by its freedom from colour and odour. Moreover, its inhalation is unaccompanied by irritation, and its poisonous effects steal imperceptibly upon the victim, gradually advancing from disinclination to exertion, to loss of power of movement, and in the next stage to narcotism and coma. It expends its lethal power primarily upon the blood, with the albumen of which it forms a stable compound that excludes oxygen, and is dislodged with the greatest difficulty. Hence suffocation by it is not merely the exclusion of air by an irrespirable gas, but the presence of a gas which has entered into combination with the blood, and cannot be separated from it. Its presence in the blood of those who have breathed it has been demonstrated.

One of the most striking examples illustrative of carbonic oxide poisoning was furnished by the death of two men in November 1889, in a hut at the Leeds Forge Company's works, lighted by water gas, where a supply tap was

carelessly left open when the men laid themselves down to rest. The examination of this case fell into the very capable hands of Dr. Thomas Stevenson.

Coal Gas products.—Following his description of gas-making, Dr. Ballard introduces one of several manufactures dealing with gas products, viz.: (1) Preparation of 'ammonia material;' (2) the manufacture of sulphate of ammonia and sal-ammoniac from the ammoniacal liquor; (3) the distillation of tar; (4) the dipping or varnishing of iron pipes; (5) the making of artificial or 'patent' fuel; (6) the manufacture of asphalte, and (7) of lamp-black.

The health features of these several trades are of no weighty importance. The making of the 'ammonia material' for the separation of ammonia from crude gas, is attended by fumes of sulphurous, and, in less proportion, of acetic acid, following on the addition of sulphuric acid to sawdust.

In making the second substance in the above list, sulphuretted hydrogen is evolved, which has to be got rid of by saturation in a closed tank containing sulphuric acid. But the business retains other drawbacks in the shape of effluvia which, with some people, 'induce feelings of depression, headache, loss of appetite, nausea or vomiting, and sometimes some oppression of breathing' (p. 131). The making of sal-ammoniac from gas-liquor by decomposition with hydrochloric acid, if conducted without due precaution, sets free most offensive vapours, which travel a very long distance.

The distillation of gas tar produces (1) light oils, from which benzole and solvent naphtha are obtained; (2) heavy oils, or 'creasote oils,' which sink in water and contain carbolic acid; and (3) anthracene, the most dense product of the series. To obtain the last-named a high temperature is necessary, which drives off carburetted and sulphuretted hydrogen. What remains in the still is 'pitch.'

'The effluvia from tar works constitute sometimes a very considerable nuisance, not only in their immediate neighbourhood, but even at a distance of half a mile or more. The vapours from hot pitch will travel as a compact white cloud near the surface of the ground to great distances' (p. 141).

Happily the effluvia produce no serious or permanent ill effects.

The Dipping or Varnishing of Iron Pipes takes place in a vertical cylindrical vessel filled with coal tar and creasote oil; the latter in great excess. A vast volume of vapour is given off, which proves irritating to the respiratory organs, and induces sickness and headache.

The three remaining small trades enumerated offer nothing special to call for description. The materials employed are productive of smoke, steam, and tar vapour.

Minor Chemical Fumes.—Several of the succeeding articles in Dr. Ballard's elaborate treatise upon effluvia from mineral substances belong rather to technical chemistry than to industrial processes viewed in connection with their effects upon health. This is the case with the descriptions given of the manufacture of carbolic and of picric acid, of aniline and aniline colours, the distillation of oil shale, and the preparation of paraffin.

As, with the great majority of chemical operations, these manufacturing processes cannot be carried on without the evolution of gases and vapours of irritating, and, occasionally, of poisonous properties, which may do harm to those immediately exposed to them, yet rarely do so, when care is taken and proper arrangements provided to secure immunity from their ill effects.

Another circumstance attaching to them is, that they are for the most part minor industries, pursued by a very small number of hands. A further reason may be advanced for omitting an account of processes and apparatus used in the chemical manufactures in question, viz., that they are in a state of perpetual fluctuation by reason of the invention of new appliances and new modes of working.

Aniline calls for examination, inasmuch as so many dyes are derived from it, some of which at times exercise a poisonous influence.

The crude material forming the basis of aniline is tar *light oil*, or naphtha obtained by the distillation of tar

derived from gasworks. The first substance to be formed is benzole or benzine. This next is converted into nitro-benzole, which, in its turn, is made to yield aniline oil, the source of magenta and of other dyeing materials. At this stage of manufacture a highly poisonous substance was introduced formerly in the shape of *arsenic acid*, prepared by the action of nitric acid upon the arsenious acid. The arsenic acid was mixed in solution with aniline oil, and the product was a crude magenta. The arsenic acid, having done its work, was removed by lime, with which it united to form waste product. But it mostly happened that a certain proportion of the poison still contaminated the magenta and various derivative colours. Happily, by amended processes, the use of arsenic acid as an oxidizing agent is dispensed with, and, in the opinion of the most eminent chemists, aniline colours, free from undecomposed aniline, are not poisonous.

In aniline factories other fumes arise, including those of nitro-benzole, of nitrous and sulphurous acids, and of the strong-smelling substance called myrbane. Aniline itself is unquestionably an active poison. Being volatile, it may enter into the circulation both by the stomach and by the lungs. Its absorption through the skin is not proven. The symptoms produced by it are those of a narcotic poison acting upon the central nervous system, causing insensibility, muscular contractions, convulsions, anæsthesia, and in acute cases, motor paralysis.

In aniline factories the workpeople are liable to a kind of chronic poisoning, exhibited by nervous derangements in the form of vertigo, stupor, muscular cramp, weakness, disordered sensibility, headache, and neuralgia. Some writers add nausea and obstinate bronchitis (Boehm on Aniline Poisoning in *Ziemssen's Encyclopædia*, vol. xvii. p. 524). Another consequence assigned to aniline is the production of cutaneous ulcers on the legs of the workmen, with pain and swelling. Cessation from work quickly removes this damage.

All aniline workers, says Dr. Roger S. Tracy (*Hygiene of Occupation*, 1879), get chloro-anæmia, with reduction of the blood-corpuscles and increase of the colourless ones. Gastro-intestinal disorders are common; constipation an habitual, and impotence an occasional incident.

Various writers have attributed many injurious effects to aniline colours among those regularly engaged in their use as dyeing materials. My own inquiries do not distinctly bear out these representations, which rest mostly upon observations made when the preparation of those colouring agents was in its infancy, and when arsenic, in some shape or other, entered as a component. There is this much to be noted; that as the same men are not always using the same dyes, they may in consequence escape. Another fact is, that idiosyncracy plays a decided part, for in a group of dyers, one or more workmen will be found who speedily suffer with skin-irritation, disturbance of the digestive organs, and head symptoms, whilst the rest go scot-free. Nevertheless, if pure aniline dyes are harmless, there appear to be many in the market which prove injurious, chiefly by their action on the skin. This fact is exemplified by numerous cases on record, where the wearing of articles dyed with aniline colours—among which that called 'coralline' is the principal offender—has been attended by cutaneous eruptions, chiefly of a popular or eczematous character. The conclusion is, that those dyes so acting are impure by reason of the presence of arsenic, or of undecomposed aniline.

Nitro-benzole, formed by the action of nitric acid upon benzole or benzine, is used in the arts, and ranks as a poisonous agent. Dr. Richardson, basing his remarks on some special investigations of the substance by the late Dr. Letheby, says (*op. cit.* p. 148) 'that long exposure to its vapour produces nervousness and stupor; but when the vapour is inhaled in the concentrated form, the drowsiness, after from three to four hours, passes into stupor and intoxication, and finally into complete coma, or apoplectic sleep. The mind remains clear until the stupor suddenly comes on, and then the insensibility is complete. The body falls precisely as in apoplexy, and death ensues in about five hours.' Dr. Letheby attributed these phenomena to the conversion within the body of nitro-benzole into aniline, but this notion has not been confirmed by subsequent writers. Dr. Richardson subjoins, from his own observation, that by acting on benzine by nitric acid the vapour of hyponitric acid is freely evolved.

This vapour produces great bronchial irritation, nausea or vomiting, and colic. M. Chevallier stated also, that the process of washing the nitro-benzine is more painful than the making of it, and that the preparation of benzine itself induces intense headache; a fact attested by Dr. Richardson.

Nitro-benzole in a liquid form is absorbed very slowly from the stomach and subcutaneous areolar tissue. It is a nerve poison acting upon the central nervous system.

Myrbane, a substance previously mentioned, is a form of nitro-benzole, having only slightly poisonous properties, unless taken in considerable doses, either by the mouth or by the lungs. Its strong bitter-almond odour and flavour has led to its employment as a scent for soaps and pomades, and to give flavour to liqueurs, and even to sweetmeats. Such uses are scarcely justifiable.

In the *British Medical Journal* for April 1891, p. 800, Mr. Thompson recounts a case well illustrating the effects of the vapour of nitro-benzole absorbed in lesser quantity than Dr. Letheby dealt with. The case was that of a man who had been busied for some hours in pouring nitro-benzole from large drums into small vessels. His complaint was of dizziness and headache. 'He had vomited once or twice, and staggered in his gait. His respiration was about 36, and the breath was very heavy with the peculiar sweetish fragrance of nitro-benzole. The surface of the skin was of a dark purple hue, especially marked on the mucous membrane of the lips and beneath the finger-nails. The heart's action was very rapid and tumultuous (160 in the minute), but the pulse was full and of good quality. The pupils were sluggish, and there was some tendency to coma when at rest.' Moving him about, with the object of securing a more rapid respiration, was carried on, as it was plain much of the poison was being eliminated by the lungs. Physical examination of the chest failed to reveal any pulmonary congestion. The urine was very dark; smelt strongly of the poison, and contained neither blood nor albumen. He made a good recovery after four or five days, but did not regain his normal complexion; as though the blood had undergone some change, and had not regained its healthy condition.

Explosive Compounds.—The rapid development of the destructive arts, and the rivalry of nations in fostering it, to secure pre-eminence in the business of wholesale slaughter, has created several new forms of manufacture, charged not only with danger from explosion, but also with serious damage to the health of those making them. I am able to cite a few examples of such manufactures. As a matter of course, in the case of some of these formidable compounds, the ingredients used, and the manner of using them, are State or trade secrets: our interest in them is limited to their effects upon health.

Dynamite.—In the chapter on mining, it was remarked that colliers are persuaded that the newly-invented explosives are more injurious to their health than gunpowder; and this notion is confirmed by all that is known about their constituents, as well as by their recorded consequences. Mr. C. E. Thomson narrates the case of a man and boy who were exposed to the smoke of 25 lbs. of dynamite casually lighted, but which, being unconfined, only 'fizzled' away like damp powder. He reckons they were exposed to it for about five minutes, the boy being at once more affected than the man. The fumes are pungent and suffocating, much resembling those of sulphur, and differ in character from those that follow explosion of the material. On reaching the surface both vomited and complained of headache. Nineteen hours after the accident the boy was found suffering from urgent dyspnœa with cyanosis, and succumbed two hours after. On making a *post-mortem* examination, there was found intense pulmonary œdema, with deep bluish coloration of the tracheal and bronchial mucous membrane, beneath which were numerous punctiform hæmorrhages. All the other organs were healthy. The man came under treatment the day next after the accident. He had remained at his work the previous day, and was not seized with serious illness till the middle of the night, some twelve or thirteen hours after inhaling the smoke. He was semi-unconscious, with a full and bounding pulse, exceeding 150 in the minute; respirations, 96; temperature, normal. Physical examination of the lungs revealed extensive and extreme congestion. He,

happily, recovered within four days from the date of the exposure. Vigorous purging and sweating was the treatment adopted (*British Medical Journal*, 1891, p. 800).

Roburite.—In the same number of the journal, at p. 801, Mr. Spurgin shortly described a case of poisoning by roburite, a substance known to contain nitric oxide and carbonic oxide. Its incomplete combustion sets free nitro-benzole. The sufferer was a youth aged sixteen, who slept for one night in a room, the floor of which had been sprinkled with roburite for the purpose of destroying cockroaches. When seen at 9 A.M. he was cyanosed, blue-black in hue to his nails; tongue, lips, and mouth nearly black; body and face livid. He was shaky and cold, with dyspnœa and hurried, laboured breathing. Pulse 135, very weak; great depression. Heat and stimulants were applied with success.

This substance came under the notice of Dr. Ross, of Manchester, from whose excellent account the following particulars are taken (*British Medical Journal*, July 1889). It causes prickling of the eyes and face, but the latter remains pallid and blue; this blueness is, however, unlike that of cardiac disease. There are thickness of breathing, palpitation, anæmic bruit and profound anæmia, torpor, indifference, and anorexia. The nervous symptoms are relative anæsthesia in patches, or one-half of the body is hyperæsthetic; lightning pains, cramps and slight paresis of legs, and attacks of absolute blindness, notwithstanding the eyes are normal. The muscles of the arms are flaccid. Urine deeply coloured, with great excess of urates. Dr. Ross regarded the anæmia as the most characteristic sign, and looked upon the nervous symptoms as allied to hysteria. Recovery followed rapidly in the six cases that came under his observation.

The same journal published a case of poisoning by another explosive, made for use in mines, under the name of '*Sicherheit.*' It occurred with a man employed as a mixer; and the symptoms were headache, hebetude, cyanosis of face and hands, rapid pulse, and deep brown urine. No chest phenomena were noted. Recovery was rapid.

Picric Acid is an essential component of some of the strongest explosives. It is present in the composition of the French government explosive known as melinite, and is the chief cause of the symptoms noted in connection with the manufacture of that substance. In the *Annales d'Hygiène Publique* for March 1891, MM. Regnault and Sarlet recorded their experience.

The making of picric acid is a first stage in the production of melinite, and is carried out by pouring nitric acid on phenol. Clouds of nitrous acid are thrown off, and owing to the heat generated, some picric acid likewise. The latter in the nascent state produces attacks of dyspnœa, with dry, hacking cough, increased respiration, anæmia, and debility, but no fever. The vapour also stains the exposed skin and the hair yellow. There are, likewise, prickling in the eyes and conjunctivitis with anorexia. After a while the cough increases in intensity and frequency, and becomes paroxysmal, as does also the dyspnœa. Hæmoptysis at times occurs, and there are progressive and profound anæmia and debility. The pulse is feeble and accelerated, and the chest betrays sibilant râles and rhonchus, which do not disappear when the fit is over. Nor does the attack end in a discharge of mucus from the chest. The heart, liver, and spleen are unaffected, the urine contains neither albumen nor sugar, although the acid can be detected in it, as well as in the liver and blood. Lastly, the nervous system is undisturbed.

Of these several explosives each has its own special pathological phenomena; though they all agree in producing severe headache, giddiness, debility, and respiratory embarrassments, and, from my own inquiries among miners, it is these general disorders that are most complained of. When dynamite is used, they will also tell of a sensation of bursting in the head, of dyspnœa prostration, and partial unconsciousness. Fortunately, a rapid exit from the poisoned air removes, within a brief period, these feelings of distress, by whichever substance caused, unless, indeed, an excessive dose be inhaled. The secret French explosive melinite has not, to my knowledge, been applied in mining operations.

The comment is unavoidable, that when we examine in detail the phenomena of poisoning with nitro-benzole, bi-sul-

phide of carbon, and various explosives, we cannot fail to recognise the existence of a series of maladies having certain common features, but which have no place in our accepted nosology. In other words, we are in the presence of a group of trade diseases unlike any ordinary group of every-day maladies which pathologists recognise and study, but upon which careful research may well be expended, and, in short, is in the interests of science demanded.

Miscellaneous Vapours in minor occupations arrest attention and deserve a passing notice. Such are those arising from turpentine, from lacquer, and various varnishes rich in alcohol and naphtha, and often conjoined with resinous, gummy, and balsamic matters.

Turpentine has many uses, but the principal one is in the composition of paint. Its inhalation is stimulating, but accompanied by headache, vertigo, and muscular weakness, and with some people, by nausea and vomiting. As most of our experience of it is gained when it is mixed with lead, a degree of uncertainty exists as to how far the disagreeable effects are due simply to the turpentine, and how far to emanations from the carbonate of lead intermingled with its vapour.

The process of flatting, that is, removing the gloss of ordinary lead paint from the surface painted by means of turpentine, is recognised in the house-painter's business as more obnoxious to health, and more productive of plumbism, than any other branch of the trade.

And it is a remarkable circumstance that, whilst house-painters, as met with in London and other large cities, suffer from gout, albuminuria, uric acid, and other urinary troubles, results there attributed exclusively to the presence of lead in the system, the like diseases are, at the most, comparatively rare among workmen exposed to lead poisoning, and often exhibiting its phenomena, where turpentine is not conjoined with the metallic salt.

Dr. Richardson states that men engaged in the process of flatting suffer 'prostration, coldness, constipation, giddiness, disturbed nervous function, intense headache, which

lasts for many hours, impairment of appetite, and anæmia. These symptoms are produced from the use of turpentine varnishes as well as from paint. Some workmen escape the action almost altogether; others are so susceptible that they will rather pay more favoured men to perform the job than do it themselves' (*op. cit.* p. 148).

Thénard concluded from experiment that turpentine robbed the air of its oxygen, leaving only the nitrogen, and it appears to be the fact that this substance in vapour causes the paralysis of the capillaries, and congestion of the brain and large vascular organs.

Another set of artisans exposed to turpentine vapour are the painter-decorators of earthenware and china, by whom turpentine is used as the medium or solvent of the mineral colours employed. When many such workers,—the majority of them being females,—are congregated in the same workshop the vapour of the turpentine becomes very pronounced, and especially if the shop be, as it commonly is, highly heated. The women, under such circumstances, are very subject to headache, nausea, loss of appetite, fainting, and giddiness. This is more particularly true of fresh hands; the older ones growing very indifferent to the nuisance. Whatever harm exists is, in my opinion, in no small degree due as much or more to hot shops and bad ventilation, as to the turpentine vapour.

Petroleum and Paraffin.—The vapours of these articles bear in their general effects on the human system an affinity with that of turpentine. In the history of the great petroleum region in Pennsylvania, we read of destruction of life when men have been overtaken by an excessive discharge of the material, and by explosions. In this country, petroleum is manufactured by the distillation of coal shale in specially-constructed furnaces, which emit a vast quantity of carburetted hydrogen that is burnt as it escapes. Apart from the smell of the petroleum, I know of no injury that arises from this manufacture, excepting rare accidents by burning, and by explosions of the receptacles of the petroleum.

But the frequent contact of the oily material will evoke a skin eruption, consisting of papules, and sometimes of nodules.

Dr. Ogston of Aberdeen made a special examination of paraffin eruptions, and described an acute and a chronic form. In the exposed hands and feet, it is the dorsal surface alone that is attacked, though the malady may seize on exposed portions of the trunk. Nodules of a bright red tint occur in the acute variety, and are due to inflammation and swelling of the hair follicles. The skin around them is also reddened and swollen, and the mouths of the follicles are gaping. Men of dark complexion with strong black hair suffer more than fair men. In the chronic form the skin loses its elasticity and becomes thickened, and so renders the movements of the hands stiff and painful. The surface then becomes occupied by raised honey-comb patches, of natural colour, made up of distended and gaping hair follicles packed with epithelial *débris*, with intervening dense integument, in which at times fissures form. The knuckles, the palms of the hands and the soles of the feet, are unaffected; but the persistence of the local morbid condition reacts upon the general health by the pain, irritation, and loss of sleep attendant upon it; and the patient loses flesh and strength.

The malady, doubtless, owes its origin to the penetration of the mineral oil into the cutaneous follicles, and subsequent inflammation with abnormal epithelial development, a condition mostly encouraged and aggravated by indifference and want of cleanliness.

Varnishes and Lacquers are of many kinds and of various constituents; but those most common consist of methylated spirit, petroleum spirit and turpentine, one or other of which forms the solvent for some mineral colouring matter, or for some so-called gum, as copal, mastic, shellac, etc. Whatever be their ingredients, these substances exhale a vapour characteristic of each, but concerning which no very definite statements can be hazarded as to their effects upon health.

The business of French polishing is a very exhausting one, in consequence of the necessity of continuing the active rubbing in of the polish until the result aimed at is fully attained. Moreover, to bring it about, the workman inhales a rather nauseating vapour arising from the spirituous solu-

tion he employs; and suffers more or less from headache, vertigo, some nausea and temporary disturbance of vision.

Polishers are exposed besides to lead-poisoning, where stains containing the mineral have been applied to dye wooden articles of furniture. This happens with the stain employed to give an air of antiquity to furniture, which Layet reports to contain 45 per cent. of lead salts. Consequently, when the surface is rubbed down with glass paper to smooth it for the reception of the polishing liquid, a dust is disengaged rich in lead-poison.

Another assertion he quotes from Dr. Bergeret is, that cabinetmakers who employ varnish made with methylated spirit are subject to tetanic contractions of the fingers, a circumstance unknown prior to the introduction of that variety of spirit (*op. cit.* p. 203).

The process of lacquering is attended by fumes proceeding from the lacquer, a solution of shellac in spirits. Owing to its being applied to the metallic object dealt with when the latter is highly heated, the abundance of the vapour is much increased. The accessory and previous part of the operation is likewise objectionable, consisting as it does in the dipping of the brass articles in a mixture of warm nitric and sulphuric acids, to clean and brighten them, and the inevitable evolution of some irritating gases, mostly in no great quantity.

Japanning is a very simple process of applying a black varnish upon the surface of an article, and then subjecting it to a low heat in a chamber or stove, heated by steam pipes. The japan varnish is made for common goods, of pitch dissolved in coal tar. For better work, ivory black, shellac, and spirit are used. For convenience sake, it is customary to place the stoves in a row behind the workers, who are generally women. This arrangement renders the workshop very hot—a condition aggravated, moreover, by the frequent necessity to open the stove doors to introduce or to withdraw the articles.

The women become habituated to the high temperature, but do not fail to suffer languor, and ultimately oppression

of breathing and great liability to taking cold, and to attacks of bronchitis and lumbago.

When the japanned goods are sufficiently dried, the surface is smoothed by rotten-stone, first of coarser, and then of finer grain, and finished off by being rubbed by the palm of the hand, covered by a mere film of the finest quality of the same substance. This operation leads to a flattening of the hand and great hardness of its integument.

Polishing with the rotten-stone is not done without producing dust; but the evil is insignificant if ordinary care be used, and the production of pulmonary troubles by it has not been noted.

The polished japanned article is next decorated as required, either by ordinary lead paint, or by specially-made enamel colours. When gilding is done, the medium used for laying on the gold leaf is 'asphaltum' in solution; but for common ware, a gilded ornamentation is obtained by 'bronze' powder laid on by a brush, and made to adhere by means of a thin glue. When about dry, the bronzed portions are rubbed gently by a cloth rag, which brings up the gold-like appearance.

The so-called bronze powder is a poisonous preparation, but it is laid on carefully on account of its cost, and does not rise in dust. Moreover, one or two workmen in a factory can accomplish whatever amount of such decoration is called for.

D. *Vapours of Mineral Acids.*—The evolution of gas from the decomposition of mineral acids in numerous chemical processes is of perpetual occurrence; but from the fact that these gases cause immediate annoyance, precautions more or less adequate are taken to guard against their accumulation in such quantities as to materially injure health or shorten life. The histories of experimental chemists prove that exposure to the noxious gases of the laboratory is not incompatible with prolonged life.

Nevertheless, though the lasting effects from acid vapours on health have not been demonstrated, it is well known that their inhalation is a temporary source of suffering, and also that the dose may be so strong as to extinguish life, a

circumstance not unknown in the oil-of-vitriol trade, when the leaden chambers have been prematurely entered for the purpose of cleaning.

We have already noticed the exposure to sulphurous vapour, where bleaching by sulphur is conducted; but even in this case, the annoyance or suffering of the workpeople concerned in the operation is largely self-inflicted by carelessness; for, in the case of sulphuring-chambers for bleaching silk or wool, these are so constructed that the vapour does not escape, unless by accident; and the operatives have no reason to enter them until the gas has escaped.

In bleaching straw, occasional entrance into the bleaching chamber is necessary to turn over the articles operated upon, to withdraw what is finished, and to introduce fresh. To do this, the operator has to cover the mouth and avoid breathing during the short period spent upon the task.

Another occupation where it is difficult for the worker to escape breathing irritating gases, is that of separating gold and silver from copper, with which they are intermixed by means of nitric and sulphuric acids. Nitrous acid, again, is often annoying in dyeing works, where it is generated in the preparation of mordants.

The effects of nitrous gas are first felt in the nasal and respiratory passages by the sensation of heat and tingling; and quickly following this, by a feeling of suffocation and spasm at the glottis, with cough and oppression at the chest. If the gas be very concentrated and abundant, suffocation may result; and if death be escaped, the irritant gas sets up inflammatory action within the chest, provokes vomiting and acute dyspepsia. Repeated and prolonged breathing of milder gas induces chronic bronchitis and laryngitis, and, at times, conjunctivitis.

Concentrated vapour of sulphurous acid, besides producing thoracic inflammation, sets up vasomotor excitement of the cardiac nerves, ending in paresis. Diluted gas, such as most often occurs in workshops, manifests no decidedly poisonous effects; although bronchial irritation survives as long as workmen continue to breathe the impure air.

Hydrochloric acid vapour presents no health features of

distinct kind differing from those of nitrous and sulphurous acid. Like these, it is destructive of life by suffocation, and has a caustic action upon animal tissue, so that in weak doses it operates as an irritant to all mucous surfaces, and in a special degree to the respiratory passages.

It is given off abundantly in alkali works, in vulcanised rubber factories, where the chloride of sulphur is employed, being a product of its decomposition; and it is an ingredient in the smoke of glass, pottery, and brickworks, to which it lends pungency.

Acetic Acid Vapour.—Like annoyance to that from weak nitrous acid gas, proceeds from the vapour of acetic acid, and the prolonged breathing of it is said to be provocative of consumption. But this statement wants confirmation by experience to be gained among workmen in vinegar distilleries. Vinegar-making reduces the proportion of oxygen in the air, by the abstraction of that element in the formation of acetic acid, and is reported to favour the onset of rheumatism.

Fluoric or Hydrofluoric Acid is used in etching on glass and china. The vessels are coated with a film of wax, presently removed by etching tools from the parts to be acted on by the acid. The fumes of the acid are most irritant and caustic, and cannot be breathed; whilst the acid itself is excessively corrosive, rapidly destroying the skin and subjacent tissues. The acid has, therefore, to be used with the greatest caution. The addition to it of sulphuric acid lessens its causticity without injuring its operation upon glass.

Carbolic Acid is, together with a substance called 'anthracine,' a product of distillation of coal-tar naphtha. In the process highly injurious vapours escape. An intelligent young man who had worked for four years in chemical works, informed me that the vapour of carbolic acid was very heavy, and productive of suffocation with more or less unconsciousness, necessitating immediate removal to the outer air. The vapour likewise stains the exposed skin brown, and if its action continue long enough, corrodes and causes it to peel

off, with a sensation of burning. Prior to unconsciousness, there is a feeling of being lifted above the ground, followed by one of falling. Anthracene vapour is less active, but its effects are more lasting. Other symptoms are dyspnœa, vertigo, headache, and debility. The labourers keep thin, though their appetite is unnaturally provoked.

E. *Noxious Vapours of Mixed Origin.*—Those here intended are such as belong to the avocation of labourers working in and about sewers and cess-pools. The evils threatening those men are due to the inhalation of mephitic gases, and to contact with decomposing matters. The consequences are so well known, that they need no detail. The one most to be dreaded is asphyxia, to which ever and anon some unfortunate sewer-man succumbs. And when such an event occurs, it usually follows the discharge of waste fluids from factories which are either themselves poisonous, or set up active chemical action with lethal products in the mixed contents of the sewers. Further, the ammoniacal vapours, mingled usually with sulphuretted hydrogen, arising from sewage decomposition, cause great irritation of the eyes and temporary conjunctivitis.

But it happens with the mixed gases under consideration, that they are made up not only of irrespirable gases, and of others directly noxious to health, but, moreover, in some cases, of miasmatic or mephitic vapours bearing the germs of special febrile maladies. Consequently, the labourers in sewers are subjected to the risk of contracting specific diseases. Nevertheless, though this danger seems obvious enough, the number of sewage labourers who fall victims to it, experience proves to be, proportionately to the number employed, exceedingly small. In fact, according to Parent-Duchâtelet, men engaged in dealing with night-soil, are not so prone to epidemic maladies as other labourers, and this idea has of late gained ground among sanitarians, who are led to regard sewers as less objectionable than many streams on the surface.

Mephitic Gases arising from the Soil are among the dangers surrounding the work of well- and of mine-sinkers

and miners. Sufficient has been said of the noxious gases of mines; they are of mixed nature; but the usual gas of wells and similar sinkings is carbonic acid.

The same gas haunts cellars where wine is stored, and where fermentation of grain or of other vegetable matter, such as the spent hops and 'grains' of breweries and distilleries,—is going forward.

Lastly, men have lost their lives when working inside boilers where noxious gases have accumulated in consequence of chemical interaction between the water or steam, with whatever accidental matters are present in them, and the metal, and intensified usually by heat.

SECTION II.—*Inert Vapour conjoined with Heat in the Form of Steam.*—The production of such vapour is witnessed in a multitude of employments, but it is a leading feature in several, and to be ranked as a disease factor.

Those we shall consider are, the occupation of dyers, of felt hat-makers, and of laundresses.

The operation of cask-cleaning in large breweries furnishes another example. For instance, as seen in Guinness' immense establishment in Dublin, the department for cleansing returned casks is of proportionate magnitude, and the labourers employed exist in an atmosphere of steam arising from the jets of boiling water injected into the casks as they are kept rolling by a machine with an iron chair placed within to act as a scrubber. At the same time, the workmen are constantly standing on a stone floor flooded with hot water. What effects their occupation may have on their health, or what form of malady is most common among them, no data exist to show.

Dyeing and Bleaching is a business of great magnitude, and embraces a large number of processes, both chemical and mechanical. It would take us considerably beyond the purpose we have in view to attempt a description of those many processes. In short, they would require for their right apprehension the description of a technically skilled dyer and bleacher. What strikes an ordinary visitor to a dye-house

is the pervading steam, emitted on all sides from the various open vessels, or vats, containing the dyeing material, and its sickly odour. An accompanying condition of labour is a sloppy floor, from the possible ill effects of which the workmen protect themselves by wearing thick wooden clogs, and usually leggings.

The art of dyeing is one characterised by very diverse methods, or, as they are called, 'styles;' each style marked by its own peculiar processes, chemical and mechanical, and by its particular dyes and mordants and 'discharges.' The dyes are either of animal, or vegetable, or mineral origin. The first named are very few, being represented only by cochineal and kermes grains; but transitional forms between them and vegetable dyes are illustrated by galls and lac, each of which is derived from the action of insects upon trees or plants. The true vegetable dyes are very numerous, and, happily, not poisonous,—a quality, unluckily, not belonging to mineral dyes at large, for several of them are distinctly poisonous. It has already been pointed out that the bright and varied colours of arsenical origin have prompted their use for tinting some materials used for ladies' dresses, for curtains, druggets, and other textiles. The usual colouring salt is the arsenite of copper. It formed the basis of the dye producing sage green. Its employment was attended by most serious, and, at times, fatal, consequences to the workers themselves, and also to those who wore the finished material. What made it so much more injurious was, that the colour did not become a component part of the fibres, but existed simply as a precipitate adherent to them, and readily detached by movement and friction. The women engaged in winding the yarn suffered most from inhalation of the dust, but neither warpers nor weavers escaped its deadly effects. As a dye, therefore, it should be rigorously interdicted. Copper salts, endowed as they generally are with poisonous properties, are but sparingly used; but lead compounds are greatly in request, particularly the chromates; and, besides furnishing colours, some of the plumbic salts are turned to less honest account,—that is, for 'weighting' the silks. Chrome, again, mostly in the shape of bi-chromate of potash, is largely employed in dyeing. Sulphate and nitrate of iron are

extensively used, serving both for dyeing materials and for mordants. Manganese has certain useful properties, but tin possesses a far higher importance; mainly as a mordant, in the shape of its proto-chloride, and as a colour in that of the so-named 'plumb spirit,' consisting of tin dissolved in nitro-hydrochloric acid. Zinc, lastly, possesses some properties of value to dyers.

This enumeration of mineral substances, many of them poisonous, will sometimes avail to interpret symptoms of disorder among dyers which might otherwise be perplexing. But, as before stated, apart from the properties of the dyeing stuffs employed, the chief health conditions of the trade are exposure to heat and moisture, and perpetual slopping, and, in consequence, great liability to take cold by alternate heating and chilling of the body in passing from steamy workshops to the outer air, and *vice versâ*. The results are, aggravated colds, inflammatory affections of the chest, and rheumatism. Moreover, from constant immersion of the hands in fluids, frequently containing alum, and from handling wet and hot materials and exercising more or less pressure, the skin of the hands grows thick and hard, and the hands themselves expand in width. The cuticular thickening must be looked upon as a happy accident, since it renders the skin more impervious to whatever injurious materials are in contact with it.

Chronic rheumatism with stiffened joints, is a frequent trouble to old dyers, and may be assigned to the constant soaking of the hands in hot liquids, just as happens with washerwomen.

Turkey-red Dyeing is a special department of the dyeing trade, demanding great care, and involving a móst complicated series of manipulations. One peculiarity is, that when once started the whole series of operations must be gone through with. Another one is, that two animal products enter into the process—one, bullock's blood; the other, cow dung. These materials lend, at least, a semblance of something offensive to the operation, but no evidence has been collected respecting their possible influence on health. Their storage will probably form the most objectionable condition. Some

fatty body is essential in the earlier stages, and from this arises a third peculiarity, namely, a tendency to spontaneous combustion. Modifications of the proceedings have been devised in order to dispense with the animal matters named.

Bleaching is more frequently than not associated in the same factories with dyeing. Chemical bleaching by chloride of lime has supplanted the plan formerly adopted of exposure for a considerable time to the action of the open air and sun, along with auxiliary agents, in the case of cotton and linen cloth. But in bleaching silk and wool, chloride of lime is inapplicable, and sulphurous acid is the agent employed.

The bleaching of straw is effected by first boiling the straw in a solution of caustic soda, after which it is well washed, and then subjected to the vapour of sulphur in enclosed cupboards or rooms, or else is boiled with bleaching powder in confined vessels. Where sulphurous acid is employed, it is necessary for a man to enter the sulphur chamber from time to time to turn or change the straw. In order to do this, inasmuch as the gas is irrespirable, Dr. Richardson tells us (*loc. cit.* p. 146) the workman holds his breath for one or two minutes whilst performing his task. 'He rarely escapes altogether from the effects of the gas, and he feels the effects still more after the straw is removed and dried.'

The process of bleaching is not so simple as might be supposed. In the case of linen, it is particularly tedious and complicated; sulphuric acid, chloride of lime, lime and soda severally playing a part in it, with the co-operation of open-air exposure. Frequent steeping and boiling are accessory operations, and hence the workers are subjected to the annoyances of steam and wet. Returns of the prevalent diseases of dyers and bleachers, of the ratio of mortality, and of average age reached by those artisans are greatly needed, and ought to be forthcoming from the extensive works in Lancashire and Yorkshire.

The possible injury to health from aniline dyes has already been considered.

Bleaching Cotton is a necessary prelude to cotton printing, and its processes consist in soaking the fabric in boiling water containing an alkali, in removing its resinous constituent by alcohol, and its oily matter by sulphuric acid and exposure to the air, and its other contained foreign matters by boiling in 'milk of lime.' Immersion in bleaching-liquor completes the essential array of operations required. Altogether a piece of cotton cloth has, in being bleached, to pass through some fifteen or sixteen operations before it is ready for printing; but the *résumé* presented serves sufficiently to show that, as in dyeing, the leading hygienic features are comprehended in exposure to heat and to steam to a high degree. We are left to surmise what bodily ailments are likely to prevail among bleachers, for, regrettably, no medical man has thought it worth while to determine what they actually are.

Felt Hat-making is another occupation in which the most prominent factor in regard to health is exposure to steam and heat. The felt is made from the hair of various animals, as hares and rabbits. In hat factories the custom is to purchase the hair made ready for use, after careful removal from the sub-adjacent integument by careful cleaning. The operation of preparing the hair and making it up in parcels is one attended by the evolution of much dust; and inasmuch as the nitrate of mercury, along with some arsenious acid is used in the proceeding, it is likewise one chargeable with poisonous effects to the workers. The preliminary processes of beating out the dust and cleansing the skins before removing the hair, resemble, generally, those practised by fellmongers, and like them referable to offensive occupations. By one process the hair is shaved off very close to the skin; by another, the skin is cut away from the hair. This latter is effected by a machine fitted with rotating knives, which slit the skin into narrow strips that look, when dried, like pieces of catgut.

When received at the hat factory, the hair is placed in boxes affixed to the circumference of an enormous wheel, whereby it is well shaken and freed from extraneous particles. After this it is transferred to a very long enclosed wooden box or channel, through which it is driven over and under a

series of revolving wheels, by a strong blast of air, to the opposite end, where it is found separated into two sorts; one consisting of well-formed hair fitted for felting, the other of a light, fluffy substance, incapable of felting and an entirely waste product. The good hair is then conveyed to the 'blower,' an ingenious machine which drives it so rapidly that it is scarcely perceptible to the eye, upon a perforated metallic cone of large size, upon which it gradually accumulates, as a result of rotation and of a strong suction air-current beneath. In a very few minutes the hair forms a filmy or fleecy layer upon the cone, and the future hat has reached its first stage of formation.

By this new mechanism the former evils of diffusion of hair and dust through the air by the action of an elastic bow to separate the stronger hair from the waste, and by subsequent manipulation, are avoided. The fleecy conical product passes from the blowing-machine to women who receive it on a sort of counter, and knead it in cloths so as to cause the hairs to further intermingle, or, in a word, to felt. To do this, the material has to be kept moistened with hot water. The effect is to considerably reduce the dimensions of the conical embryo hat, and the essential operations that follow thereafter are similar in character and effect. The next proceeding is to steep it in hot acidulated water, and to pass it between obliquely-fluted rollers, which press out the fluid and consolidate the material. Or where this machine is not in use, the same end is accomplished by manual labour; the men standing around a caldron of hot water acidulated with sulphuric acid and engaged in folding and unfolding the felt as they roll it with a kind of rolling-pin. Similar acts of kneading and pressing go on until the conical felt hat has reached its requisite dimension and thickness. After this stage it goes to the dyers, and on returning from their hands it has to be roughly shaped. To effect this, the felt is softened in hot water and placed on a hot metal block, which gives it its proper shape. It remains now to trim off the rough irregular edge of the brim, and this done, to sandpaper the whole surface. When the lining is put in, the hat is ready for sale.

Inferior felt hats are made from cotton. This is carded,

and a sliver produced which is next gathered into a sort of thick, soft rope, and by the aid of a clever machine is then made to assume the same conical figure as when hair is used. From this stage the self-same felting operations proceed as as already described in making hair-felt. However, before it is built up in the form of a hat, the cotton-felt has its surface sheared very smooth by an ingenious and powerful machine invented in America, the working of which is intrusted to women.

To make this account more complete, it must be mentioned that methylated spirit is used as a dressing, and has been charged with producing inflamed eyes and photophobia, headache, lassitude, and nervous troubles. But, as before noted, the most mischievous materials employed are mercury and arsenic, in the preparatory stages of preparing the hair for felt-making. Happily, felt hat manufacturers purchase the hair ready dressed and cleansed for use, whereby their workmen escape the poisonous consequences of which the skin-preparers run the risk. These people are few in number, and no history of their condition is attainable, but they certainly call for the services of the inspectors of factories. Leaving out of sight this preliminary occupation, we perceive that felt hat-makers are exposed, in some portions of the trade, to dust, and in others to a high temperature and abundance of steam. As remarked before, the evolution of dust in preparing the hair for the blowing-machine, and the first stage of felting, is almost or altogether avoided by the highly ingenious covered machines now in use. However, in the sandpapering to smooth the felt hats, and still more in the shearing to cut closely and smoothly the rough surface of cotton-felt, there is considerable dust produced. Still the very nature of the dust leads it to cohere, unlike mineral and many other dusts, and thereby renders it less harmful. In the case of the shearing-machine, its revolutions toss the dust very largely upon the female working it, an evil that could be avoided by placing it in front of it a tube connected with an extracting fan.

All the felting being done with heat and moisture, especially when the material reaches the presses and tanks, there is an immense evolution of steam—some of it laden

with acid—clouding the workshops, and rendering them very like vapour baths. This exposure to steam favours the development of lung troubles. Again, the different kinds of work pursued require the standing posture, coupled with considerable physical exertion both of the trunk and arms; and, according to our own observation, the workpeople—particularly the women—acquire a washed-out, pallid, and languid appearance.

Lévy says the felt hat-makers suffer much from fissures and abrasions of the skin of the hands, owing to their almost constant contact with hot and acid water. This occurrence did not arrest my attention among the workmen brought under my notice.

The teaching of vital statistics is to the effect that, though in less degree than formerly, hat-making is unhealthy. Its mortality figure is 1040, and, writes Dr. Ogle, 'To judge from the sample of deaths and causes, as tabulated, . . . the conditions under which hatters work lead to excessive drinking and its consequences, liver disease, suicide, and also to phthisis and tubercular affections' (*op. cit.* p. 40). These inferences must be accepted with caution; for as their author remarks, the total number of deaths analysed was but small.

Ratcliffe calculated hatters to possess an inferior vitality of one year, compared with other tradesmen; and concluded that, in early life, they have an increased rate of mortality with a low average of sickness, whereas in middle life the ratio of mortality was low, and that of sickness high.

It is proper here to observe, that the statistics just quoted relate to hatters in general, no distinction being drawn between the makers of silk and of felt hats, notwithstanding that the circumstances of labour in the two branches of the hat trade vary widely.

GROUP IV.

THE ACTION OF EXCESSIVE TEMPERATURES.

Heat and Cold are a cause of numerous disorders associated with employment. They, however, are rarely found acting alone; on the contrary, they are co-factors with a majority of unhygienic conditions, such as gases, vapours,

fumes, and dust. And so far as concerns heat, it enhances the activity of all morbific agents by promoting diffusion, and, indirectly, by diminishing the power of resistance by lowering vitality. But the examination of the part played by heat and cold in producing disease is a subject of general pathology, and needs no discussion in the present place.

Cold *per se* in the arts plays a very inconspicuous part as a cause of disease or injury. When intense and applied locally, as is well known, it is destructive of living tissue. In less intensity it may be the cause of pain, as when the unprotected surface is brought into contact with the metallic fixings of ice-making apparatus, or with ice itself, as happens to fishmongers and others. Cold currents of air, when they impinge on the surface, are a prolific cause of a multitude of disorders that do not need specifying. The ill effects of cold are more felt when the system has lost power of resistance by sedentary labour, or prolonged stay in a heated atmosphere, or by over-fatigue and nervous depression.

Heat, on its part, is a factor of disease in a large number of occupations. When excessive, and in connection with solid matter, it is an every-day cause of accident, as witnessed in iron foundries, glass-works, and other manufactures. Conjoined with moisture, as seen wherever steam is used as a motor force, it produces grievous harm by scalding; and where temperature is comparatively moderate, heated vapour relaxes the whole system. Heat conjoined with dry air is far better tolerated.

Exposure to intense heat is the lot of metal-casters and of the men employed in steel-making works; of the casters of statuary; and, in a somewhat less degree, of glass-blowers, of furnacemen and puddlers in iron forges; of stokers, especially those working on board ship. Other examples occur in the case of men employed at Turkish baths and in sugar refineries, of boiler-cleaners, and of metalliferous miners working in very deep and badly-ventilated mines.

The prevailing rule respecting those employed at high temperature is, that they are thin and more or less anæmic. Heat generates thirst, and it seems that, if fluids be indulged in, in large quantities, a semblance of stoutness and robust-

ness may originate, which is very misleading when looked upon as a sign of active nutrition and bodily vigour.

This state of things is at times exemplified among Turkish bath attendants, puddlers, and others working with intensely-heated metal, whether water or beer drinkers.

There is, unfortunately, a complete lack of statistics that might show the effects of high temperature upon workmen exposed to it, and nothing exists to help us in forming an opinion than records of individual cases of suffering. It is a problem that might well be solved by medical men whose practice lies among such labourers; and something beyond the general conviction that stokers and furnacemen on board ship are sickly and short-lived, should be arrived at from the opportunities for investigation possessed by the medical officers of our immense steam fleet. Quotations given in a preceding page respecting the prevalence of acute inflammatory chest affections of stokers working aboard the steamers on the Great Western rivers of the United States (see p. 117) suggests that a similar series of phenomena have only to be looked for in our royal and commercial navies.

Glass-making is a trade in which exposure of the workers to great heat is the most prominent feature; and a general notice of it may therefore with propriety appear in this chapter on heat as a cause of disease.

The most numerous body of artisans occupied in glass-making are the 'blowers.' They work immediately around the open-mouth furnaces, and close to the pots of molten glass, from which they take supply for blowing. Consequently they are exposed to intense heat and light. When they have taken up sufficient molten glass on the end of their rods or blow-pipes, they recede a short distance from the centre of heat; but are still within its influence which, too, is augmented by the mass of viscid glass they are operating upon. Besides, from time to time they have to approach the furnace mouths very closely, to re-heat the article they are engaged in blowing and shaping.

Glass-casting involves similar exposure, but without the exertion of blowing. Indeed, Mr. Ashley has patented a

most ingenious and effective machine for manufacturing glass bottles and tumblers, which altogether dispenses with blowing, and also lessens the duration and degree of exposure to the heated 'metal' attendant on the old plan of casting those articles.

The casting of plate-glass in large sheets is a special department of the trade, in which the outpouring and spreading of the molten glass, and its subsequent rolling on the metallic table subjects the workmen for the time to intense heat.

The glass-blower has an assistant and also one or two lads, who detach the duly-shaped article from the rod and carry it to the annealing furnace. Moreover, besides blowers there is another description of workmen known as 'founders,' who are concerned with the production and heating of the materials to form the glass. Along with these workmen may be classed the 'mixers,' who mingle the ingredients of glass, and who, if they escape the evils of great heat, run the risk of injury from the dust of the materials used,—sand, carbonate of lime, or mountain limestone, soda-ash, arsenic, and lead. The danger from the last is most to be feared. The arsenic, doubtless, is quickly vaporised by the heat, and has not been proved to be obnoxious to the blowers and casters, although a careless mixer might readily suffer from it whilst in the shape of powder.

The heat is generated by coal fires attached to each furnace; or otherwise by gas mixed with air acting upon a large mass of the crude materials in a vaulted furnace chamber. The use of gas dispenses with most of the smoke and dust that beset glass-works, and in equal measure diminishes the evils of the trade.

The mixing of the sand with other components is usually done in sheds, and by the simple aid of shovels, just as men would mix the materials of mortar; but recently a special mixing machine has been brought into use.

In the case of the workers in a glass factory, the cognisable disease factors are:—Excessive heat and profuse sweating, with more or less smoke and dust; the presence of poisonous dust in the mixing of materials, the effort of blowing, and exposure to varied temperatures.

The great heat and sweating necessarily induce painful thirst, to allay which the workmen drink largely. Formerly beer was the fluid most consumed; but, at the present day, it is water or herb beer, experience having taught the men that beer rendered their labour more fatiguing, induced serious liver diseases, destroyed appetite, and was largely accountable for the heavy mortality among them, and that, too, at a very early age.

Unhappily, this temperance at work is not observed when work is over; then, too often, the love of strong drink gains the mastery, and by acting in conjunction with other habits of dissipation and shortened hours for rest and sleep, produces a high rate of mortality at early ages. Whence it happens that the employés met with at glass-works are young, and for the most part, when still under forty years of age, are pale and sallow and thin, and look prematurely old and worn out.

But their more distinctive maladies are those of the respiratory organs: bronchitis, dyspnœa, emphysema and secondary heart disease, with dropsy and liver disorders, and rheumatism. The act of glass-blowing will account for emphysema. The expiration required is very forcible, and necessarily repeated at brief intervals throughout the day, whence it is that a considerable strain on the air cells is incurred, and therewith more or less interruption to the circulation, both through the lungs and heart. The interruption of the circulation is displayed by the suffusion of the face in the act of blowing; while the strength of the blast demanded is exhibited by the thin flaccid buccal muscles, which, from over-use and loss of power, bulge out like an inflated bladder. Indeed, I was assured that they sometimes in old hands actually rupture.

Now and then lads who commence as blowers suffer hæmoptysis from the exertion, and soon grow asthmatic. Indeed, glass-blowing is a division of labour only suitable to robust men with good chests; others not so fitted break down speedily. When children of ten or twelve years of age were put to the work, they became stunted in growth, the knee- and ankle-joints weakened, and ultimately deformed.

The iron blow-pipes are of considerable weight, and by their frequent handling, especially when more or less heated,

as they commonly are, they cause whitlows, and horny thickenings on the inside of the hands, which become at the same time expanded and thick.

The heated and rarefied air of the glass-house necessarily occasions strong draughts of cold air, from without which, by impinging upon the scantily clothed men, bathed in perspiration, frequently set up colds, passing into inflammatory lesions of the thorax, or into rheumatism of some form.

It has been already remarked that the injurious business of blowing may, in the making of much hollow ware, be dispensed with by the adoption of machinery; and Mr. Ashley's invention, besides saving the lungs of glass-makers, renders another service to them of no mean importance. According to the prevailing practice, the man who dips his rod into the molten metal proceeds to blow it into a hollow pear-shape body, and this done, hands the rod with the attached heated glass to his mate, who proceeds to blow it into a large globular figure, and then by rapid rotation and whirling, and some minor acts, gets the required shape and thickness. This passage of the rod from one mouth to another has been the means of conveying syphilis from an infected workman to another. This serious evil finds no place where Ashley's patent is adopted.

As in other occupations accompanied by great heat, the workmen suffer with headache, giddiness, great prostration, and occasional faintness. The complexion is usually pallid and unhealthy-looking, and the entire aspect one of languor and feebleness, especially where the business has been entered upon in early youth. Owing to the last-mentioned circumstance, moreover, the legs are feebly developed, the ankles and knees weak, yielding under the weight of the body, and growing deformed.

There are several subsidiary departments of the glass manufacture in which other elements of disease take the place of heat. Such are illustrated in the processes of flatting, frosting, grinding and polishing, cutting and engraving.

The business of flatters is to grind level and smooth the bottom of tumblers and other table glass; an operation done

on a horizontally rotating grindstone with the aid of water and sand. Frosting is done by filing, or by means of a bar of glass with sand; and, fortunately, is a wet process. Sand and water, again, are used in grinding and polishing plate-glass; operations performed by machinery, on a revolving table or bench, on which the glass is placed, whilst a massive iron 'runner' travels over the surface of the glass. Polishing is done after the completion of the grinding, mostly with the aid of rouge, and is a dusty operation. There is also a process called 'smoothing,' in which hand-power is used to work the face of one piece of plate-glass upon another, with an intervening layer of fine emery powder and water.

In grinding and smoothing plate-glass, the free use of water leads to much wetting of the clothes; and consequently to liability to taking cold and rheumatism. Smoothing is done by women, and is heavy work where large plates are dealt with.

Cutting and engraving on glass are artistic operations, performed by small, fine-edged wheels, rapidly rotated, and having their action assisted by emery and putty powder. As the latter is a compound of lead and tin, calcined and then reduced to fine powder, the evils of plumbism, constipation, colic, and paralysis are introduced into the business. To what extent lead-poisoning may occur, is dependent upon the sanitary construction and ventilation of the shop, the presence or absence of a fan to withdraw the dust, and the amount of care the artisans take of themselves, by wearing respirators, and by general attention to cleanliness.

Besides the cutting wheels, brushes are in use, but are specially objectionable on account of the dust they detach and diffuse through the air. The putty power is likewise employed in polishing flint-glass.

Glass-cutting has the further disadvantage of being a sedentary occupation, requiring a stooping posture; and, to add to its evils, the workshops are commonly kept highly heated. Hence it is not surprising to read that few of these artificers live beyond their fiftieth year.

Glass is frequently tinted by metallic oxides; those most commonly resorted to are the oxides of manganese, copper,

cobalt, and gold. The depth of tint is largely regulated by the degree of heat the colouring materials are subjected to. Carbon is used for cheap black and amber bottles.

One other point may be mentioned here in connection with glass-making; viz., the exposure of the eyes to vivid light, which, as elsewhere seen, is a source of disease. To escape its effects, no means are used by the makers. Coloured glasses relieve the glare, but, if inserted in metal frames, these get so heated as to burn the skin; and if suspended by non-metallic cord, the evaporation from the skin bedews the glasses and frustrates their utility.

Iron-Workers at Forges and Furnaces represent a class of labourers subjected to great heat; but as happens with well-nigh every occupation, there are other factors in operation, among which may be named intense light, exposure to strong currents of air and, more or less, to the weather, and to accidents by burning and explosions.

In the chapter on noxious vapours, the preparation of iron-ore by calcination preparatory to its transference to the blast-furnace has been described. When so far advanced, the calcined ore is conveyed to the blast-furnace into which it is thrown, after being mixed with limestone, coke, and coal in certain proportions. The limestone acts as a flux, combines with useless material in the iron, and produces a waste substance called slag, which lies superincumbent upon the molten iron, which sinks to the bottom of the furnace. From time to time this slag is allowed to flow out through an aperture; and about twice a day the furnace is tapped at a lower level to allow the iron to escape. As the metal flows out, it is conducted by channels to rough moulds formed in a layer of sand, wherein it assumes the form of the elongated masses known as 'pigs.'

The labour of blast-furnaces is heavy. It occurs in stoking or stirring the molten substances by long, heavy iron rods, and in other ways; and is accompanied by exposure to intense light from the interior of the furnace when tapping is done, as well as from the metal withdrawn; to powerful blasts of fiery and suffocating gases, with more or less dust, ejected at

intervals from the apertures; to the constant risk of burning, and to injuries to the eyes by the ejection of red-hot particles. As a matter of course, the furnacemen are subjected at intervals to intense heat, and, at the same time, since the furnaces are out-door structures, to the inclemencies of weather.

The presence of these conditions of labour implies colds, thoracic inflammation, rheumatism, irritation of lungs by dusts and gases, with resultant dyspnœa or asthma, and various accidents. The work done requires a strong development and bodily vigour; but even these qualities collapse after comparatively few years' occupation.

Puddling Iron.—The pig iron produced by the blast furnaces is too impure for use in manufacture. In consequence it has to undergo the process called puddling to remove its impurities. This is done in specially constructed furnaces, wherein the mass of iron is stirred about whilst in a molten state, until it assumes a viscid form, when it is worked into a ball, and then subjected to a heavy 'Nasmyth' hammer. The men who work the iron in the furnaces by means of long iron rods are called 'puddlers,' and the man who has charge of the steam-hammer is named a 'shingler.'

The next business is to roll the still soft iron into rods or rails, or into plates, by rolling-mills, or other machines. Omitting further details of the manufacture, it is quite evident, from what has been stated, that puddling and allied operations entail heavy labour, very strong heat and light, danger of burns, and the currents of chilly air which will beset every form of half-open shed, within which a high temperature is produced by the nature of the work performed. The consequences to health generally are those already noticed in the case of blast furnacemen. In both sets of workmen the eyes suffer by the burning light of molten metal, and from injuries from particles thrown off in working the metal. Evils of this kind are further discussed in the chapter on Over-use and Strain.

Apart from accidents, furnacemen, forgemen, and puddlers are liable to no special causes of illness due to the metal worked. Their labour is very heavy and exhausting, by

reason of the heat and sweating, but in most branches it is frequently interrupted, and not pursued continuously for many hours, their wages being regulated by the number of 'turns,' or what is about the same thing, the quantity of malleable iron they have produced.

The men, to a great extent, work with little or no clothing above the waist; they sweat profusely, and they drink very freely of 'herb' beer, cold tea, and meal water; experience teaching most of them that the imbibition of strong liquids when at work is hurtful.

As a class, it may be said of iron-workers that they are of larger frame and stronger than factory operatives generally. This, without question, arises from the law of natural selection. It would be useless for the small and weak members of society to compete in the calling with stronger men; and the laboriousness of the work itself would be deterrent.

Nevertheless, although in stature and natural vigour iron-workers excel most labourers, yet observation shows that their powers are seriously taxed by their occupation, and in no small degree by their prevailing mode of living, for they prematurely lose flesh and healthy colour. If a stout puddler be pointed out, the accompanying explanation usually is, that he is very free with beer and not addicted to regular labour. The general outcome is, that these iron-workers occupy a low place in tables of vital statistics.

Rheumatic affections, particularly lumbago and sciatica, are among their most common ailments. Many of them contract chest diseases, both acute, and in the form of chronic bronchitis, and an average percentage become consumptive. The evils of their occupation are augmented by the foolish exposure of themselves, when highly heated and sweating, to the outside air in a half-clad state; by their general indifference to hygienic laws in their habits and mode of life. If old men are not to be looked for in the employment, a larger proportion of middle-aged forgemen than is met with might fairly be so; but the fact is, their career is a short one.

Conversion of Iron into Steel.—This, when performed by the Siemens and Bessemer furnaces, is a business attended

by intense heat, and demanding the strongest exertions. The process also is, unhappily, liable to the occurrence of alarming accidents by explosions, and to lesser ones by burning. The vivid light causes temporary blindness, just as does looking at the summer sun at noon-day; but, as will be seen by reference to the chapter on 'Over-use and Strain,' it is not sufficiently demonstrated that permanent eye-disease is consequent upon it. Heat and exhaustion from heat and over-effort are the health consequences of the employment.

The rather gloomy account respecting the health of men working by the old method of steel-making, presented by Dr. Greenhow, appears not to apply to those engaged in the conversion processes invented by Bessemer and Siemens. Dr. Atkinson, of Crewe, whose communication has several times been quoted, says of those employed in the work, they are all fine fellows, and although subjected to extreme changes of temperature at one time attending upon near exposure to molten metal, and at another to cold blasts rushing in upon them from without in their desire to get cooled after profuse perspiration, yet they exhibit no ill effects, but, as a class, increase in bulk, and have excellent appetites, better than what they enjoyed when in the position of ordinary labourers. Moreover, as pointed out elsewhere, they suffer in no special degree with ophthalmic troubles from vivid light.

GROUP V.

ELECTRICITY.

This agent, considered in the light of a cause of industrial diseases, has not, as yet, received attention, and, in all probability, is one of very limited range. At the same time, it is a very obvious cause of injury and death when its tension is considerable and human beings are brought into connection with its current.

It remains to be seen whether the presence of a large number of machines within the same apartment, for instance, as seen in the General Post Office Telegraphic Department, produces any effect upon health.

Indirectly, its practical applications we can well conceive to be possible causes of damage to healthy function; as, for example, the constant watching and reading telegraphic messages,—an occupation causative of strain of the attention and of the visual organs. Another one suggests itself in the unceasing noise and vibrations of the electrical instruments, as a probable cause of headache and nerve disturbances.

Again, where galvanic currents are in use, we may recognise a cause of disordered health in the acid fumes generated. In the use of Morse's machines the hands frequently got pricked or scratched.

GROUP VI.

ACTION OF ABNORMAL ATMOSPHERIC PRESSURE.

Compressed and Rarefied Air has a very limited range of action as a cause of disease in the various occupations pursued by man. Diminished pressure or rarefaction is a condition waiting upon mountain climbing and ballooning. It makes itself felt among the metalliferous miners of Utah and adjoining States, where work is pursued often at an elevation of three or four thousand feet above sea level, and constitutes an essential factor in what is there known as 'mountain fever.'

Increased pressure is best illustrated by the records of bridge-making by means of 'caissons' or coffer-dams; enormous iron tubes sunk deep in the bed of a river. Dr. Andrew H. Smith, of Brooklyn, New York, was among the earliest authorities to draw attention to the effects on health flowing from the adoption of this plan of bridge-building, as witnessed by himself in the construction of the grand bridge uniting New York with Brooklyn. The collection of symptoms met with he named the 'caisson disease.' Various French physicians also have described the phenomena, and among them M. Antoine-Édouard Foley, who speaks from his own experience derived in the course of the construction of the bridge across the Seine, at Argenteuil. For the following facts I am mainly indebted to this writer. The enormous iron tube, or caisson, is sunk in successive sections, bolted together, and ultimately filled with concrete. On the surface

is a mechanical construction, consisting of three chambers; the central one circular in direct communication with the shaft which is being sunk. On either side is a chamber shut off from it by an iron door accurately fitted, but capable of being opened as required. One lateral chamber is intended for the entrance of the workmen, the other for their exit. The door of the former gives admission from without, the one within it communicates with the central chamber and shaft. The individual on entering closes the outer door behind him, and then opens an aperture through which the compressed air rapidly flows; and when the pressure in the two spaces is about equalised, he passes into the central division, closing the intervening door. After the same fashion, in reverse order, he retreats from the exit chamber, having first permitted the entrance of the outer air into it.

The high pressure exists in the central chamber and throughout the length of the working shaft, at the bottom of which the men are employed in excavating and sending up the soil from the bed of the river. The degree of pressure will increase with the depth, and varies from a fraction of an atmosphere to three and even four atmospheres.

Descent in a diving-bell exhibits similar phenomena on a slighter scale. The symptoms described vary, in different persons, according to constitutional states, and are lessened in intensity by usage. They are more severely felt when the pressure is removed in the act of quitting the apparatus.

Compression raises the temperature of the air, its capacity for holding watery vapour, and its power of supporting combustion. Many of the primary symptoms are of a nervous character and disappear by familiarity with the business. First among those specially belonging to it, are crackling noises and lancinating pains in the ears, due to the unequal pressure of the air on the two aspects of the tympanum; these disappear when the air permeats the Eustachian tube and re-establishes equality of tension. Other symptoms are:—The sensation of a heated atmosphere; a feeling of tension in the nasal passages, soft palate and lips; an alteration of the *timbre* of the voice, and even aphonia; whistling becomes impracticable, and the sensibility of the skin is reduced. The pulse rapidly becomes thready, and at times,

imperceptible, and the circulation languid, though with no accompanying lividity; for the increased oxygenating power of the air assimilates the venous to arterial blood. Lung capacity is augmented, whilst the chest movements are inactive; a sense of activity pervades the system; perspiration is excessive, but does not cause thirst, and the appetite is large. After a brief sojourn within the tube these phenomena vanish; the natural voice-sound and the power of whistling return. On the return journey to the exit chamber and to the outside air, the symptoms recounted appear in reverse order, and unfortunately with greater severity. The moisture within the exit chamber is condensed and made visible as a fog, and as rarefaction goes forward the air grows quite cold. In the case of healthy persons and where no excessive fatigue is undergone, recovery on again respiring ordinary air is rapid and complete. But if exposure to compressed air has been too severe, or some constitutional weakness lends it a morbid activity, the workman emerges in a state of depression, with ashy pallor and feeble, uncertain gait and absence of appetite. These untoward symptoms soon disappear if the labourer returns for a time to the compressed air-chamber.

It not seldom happens that, on leaving the compressed air, some amount of blood-oozing takes place from the mouth or nose, but with no pain. Events are different if the individual has previously laboured under coryza or chest pain; for in such cases there is great suffering as the hyper-arterialized blood returns to the previously compressed tissue The skin too, which, in like manner, has been under compression, expands and regains its fulness, though with the onset of severe prickling pain, ardent heat, and intolerable itching. This erethism of the skin soon yields to profuse sweating.

When pressure has been excessive, there arises muscular arterial congestions with most painful swelling, which invade the tendons and synovial sacs. The muscular congestions and swellings display themselves chiefly in those muscles that have been most exercised, and are equally slow in their appearance and disappearance.

M. Foley cannot confirm the statements of some writers

that there is congestion of the internal viscera; nor has he met with apoplexy and paralysis as consequences of compressed air. This, his individual experience, he remarks, may be due to the more careful oversight exercised over the workmen by masters and doctor. As after-consequences he enumerates permanent deafness, or, now and then, the opposite condition, exaggerated hearing, lasting congestion of the middle ear or of the mastoid cells; periostitis and tumefaction. It happens, also, that an excessive secretion of wax forms within the meatus, either with or without pain. The nasal fossæ again may remain congested, with attendant coryza; the tonsils enlarged, the voice grows hoarse, and the speech stammering. The respiratory apparatus escapes unhurt.

M. Foley seems to disbelieve in the occurrence of congestion of internal viscera, though *à priori* considerations pronounce in favour of it. The profuse sweating that supervenes is but in part due to the labour undergone, being chiefly owing to saturation of the air. As one of its results, is increased density of the urine.

Other symptoms described are, epigastric pain and vomiting, headache, vertigo, incoherence, sometimes double vision, neuralgia, and paralysis of lower extremities, both of sensation and motion.

The phenomena attending the passage of the workmen from compressed to the ordinary outside air, are rightly assimilated to those of persons who pass from the air at the sea-level to the attenuated atmosphere of mountains, or of those high aerial regions reached by balloons. These phenomena M. Foley refers to under the convenient term of 'decompression.' Of such are the fluxions of blood from the mucous surface of the mouth and of the upper portion of the respiratory passages. But there is this difference between these fluxions and those extravasations seen in men emerging from compressed air. In the former case, the blood exuded is dark and venous; in the latter, bright and red, owing to its highly arterialised state from the abundance of oxygen in the compressed air.

Otherwise, the features of the series of the two states contrasted are alike generally. For instance, the production of

the abnormal sensations in the ears, weight of head, disturbed mental function, vertigo, somnolence, and lastly, apoplexy. The injected conjunctivæ, pallid skin, lassitude, moral prostration, heart disturbance, cramp, intestinal pain, nausea and vomiting, must be looked upon as a collection of symptoms, assuredly indicating internal congestions of the liver, spleen and other organs, and imperfect hæmatosis. However, this difference obtains, that those employed in compressed air have the advantage of more perfect oxygenation of the blood; and, further, the change undergone is more sudden when a compressed air chamber is quitted, than when rarefaction follows upon mountain climbing.

It will not escape notice that some of the details adduced in this comparative sketch—especially the recognition of internal congestions—contravenes M. Foley's general impression and experience as previously described.

Dr. Smith's history of caisson disease differs in several particulars from that of Dr. Foley; and the impression gathered from the abstract of his essay, as given by Dr. B. W. Richardson (*British and Foreign Medico-Chirurgical Review*, January 1875, p. 234) is, that the mechanical arrangements for working the caissons in the building of the New York bridge, were less elaborate and efficient than those used in France, and that the labourers were less effectively looked after. Thus Dr. Smith represents the production of extreme pain in one or other of the extremities, chiefly in the inferior, at times passing upward to the lower part of the trunk; likewise of headache and vertigo. And he adds, that the 'above symptoms are connected, at least in fatal cases, with congestion of the brain and spinal cord, often resulting in serous or sanguineous effusion, and with congestion of most of the internal viscera. . . . This congestion may be evenly distributed, or it may vary in intensity in different localities. This is especially the case as regards the spinal cord. In some instances extravasation of blood takes place. In most of the published cases there was found also more or less serous effusion in the arachnoid. . . . When sufficient time elapses before death there may be softening of the brain, occurring in spots. This is probably due to occlusion of the vessels by coagula formed during the primary congestion.'

The liver, spleen and kidneys are likewise described as congested, but the lungs escape, presenting no other change than simple hypostatic congestion. 'The one essential cause of the disease is the transition to the normal atmospheric pressure after a prolonged sojourn in a highly condensed atmosphere,' and the effects will be regulated by the time of exposure and the degree of pressure. Some escape the disease altogether and others suffer but in slight measure, and, in Dr. Smith's belief, the first of the concurrent causes is a special predisposition. This cause is predicable of full-blooded men generally.

On comparing the accounts of the two authors, the impression arises that the apparatus in the American undertaking was less perfect, and the labourers less under control. The American physician had the opportunity of extending his pathological observations by autopsies, whereas the French doctor does not appear to have had a death among his labourers.

Rarefied Air.—The effects of rarefied air are more familiar than those of compressed, having been illustrated largely by the adventures of balloonists and of mountain climbers. In the one case as in the other, constitutional states, or personal peculiarities, possess great influence on the consequences. The ascent of great heights is attended by quickened and laborious respiration, which, if exertion be made, advances to dyspnœa, rapid cardiac action and pulse, bleeding from the mucous membranes of the nose and mouth, headache, drowsiness, loss of senses and memory, mental depression, thirst, nausea, vomiting, loss of power in the limbs. It has, however, to be remembered that the consequences of rarefied air at considerable elevations are inseparable from those of reduced temperature which accompanies it.

As illness induced by rarefied air can be scarcely called a disease of occupation—except in the case of a few aeronauts and mountain climbers, and of some miners, already alluded to, called upon to live at a considerable elevation—no further discussion of the subject is required in this place.

GROUP VII.

PROLONGED USE, STRAIN OR PRESSURE, OR FRICTION AS A CAUSE OF DISEASE.

Were it not that we are only concerned with conditions of trade productive of disease, we might refer to at least one of the group now to be dealt with, namely, use, as a physiological or conservative principle. The special senses are all improvable by use; and one chief argument urged in favour of the entry upon some forms of labour in childhood is, that unless the hands are trained by early usage to effect certain mechanical acts, the necessary skill is never acquired. And not only are tactile precision and aptitude gained by use, but sight, hearing, and taste are likewise developed in power and range, both with adults and children.

The possession of a high degree of sensibility in the fingers is a requisite in the performance of many mechanical actions, in connection both with machinery and without. The deftness and accuracy of movement of the fingers and hands in numerous manual operations is a phenomenon which strikes the onlooker. The rapidity with which compositors handle the type in setting it up, and likewise in its subsequent 'distribution' and sorting, is an example in point. This same fact is further illustrated by the exceeding rapidity of finger-movements, the accuracy and delicacy of touch, of skilled pianists, who, unless trained from childhood, must have laboured in vain to attain the proficiency exhibited. But bluntness of touch is ofttimes an advantage to the worker exposed to influences calculated to wound the skin or to cause pain; such as elevated heat and strong friction. Happily in such instances nature intervenes by an extra development and hardening of the epidermis to ward off the threatened injury.

But if use within certain bounds acts beneficially, yet beyond those limits and to the extent of over-use and strain, it is attendant with many ills. In regard to this matter no rule can be laid down. This is illustrated by what is

known respecting the sense of vision, of which I will now speak.

Over-use of the Eyes.—The remarkable manner in which the eyes escape injury from what appears excessive use, in the case of watch and clock makers and jewellers, has been already described. On the contrary, it is not proven that the like immunity is enjoyed, or at least not to the same extent, by compositors, school teachers, and diligent readers and writers. Ophthalmologists seem agreed that short sight is an increasing evil among scholars and teachers; yet they, at the same time, recognise the correctness of Dr. Liebrich's views, expressed many years ago, that this circumstance is attributable largely to ill-arranged lighting of schools, and not solely to the greater use of the eyes.

Another prevailing belief is, that puddlers, furnacemen, glass-blowers, and others, whose eyes are subjected to vivid light, suffer above the average of workmen in other trades, from eye lesions, especially cataract and some inflammatory troubles. This is highly probable on physiological grounds; but I know of no statistical data collected in proof of it. Moreover, an appeal to statistics need be made with caution, because those workmen are exposed to the combined operation of light and heat, and to actual damage to the surface of the eyes from incandescent particles thrown off from molten metal. The heat of a furnace is, at times, of itself sufficient to singe the eye-brows and eye-lashes, and to provoke inflammation of the outer tunics of the eyes.

The impression that internal mischief follows upon exposure to intense light, in the occupation of puddlers and furnace hands, receives the weighty support of Mr. Lloyd Owen, who is persuaded that cataract is abnormally frequent among them. Nevertheless, some surgeons well competent to pronounce an opinion hold the reverse belief. On this subject I will quote from a letter kindly sent me by Dr. Atkinson, medical officer for many years to the extensive engineering works of the London and North-Western Railway Company at Crewe. Speaking of the men engaged in steel-making by the Bessemer process, whose eyes are subjected to the blinding glare of the molten metal, he states that he

has known of only one case of eye disease among them. He adds, 'Though we have a great number of furnaces (gas, and coal, or coke), I have never yet, during my eighteen years' experience, had to remove a workman for eye disease.' Smiths, however, doing light work, requiring great and quick heat (a white heat), complain of dimness of vision. When removed to an ordinary smith's shop the eyes improve, but do not wholly recover.

There is a similar diversity of statement as to the occurrence of eye mischief among furnacemen between other medical men of large experience. It might be surmised that engine-drivers and firemen would suffer from over-strain of eyesight. But though 4000 such workmen are employed on the line, 'their eyesight generally remains good to a green old age. Their sight is tested every year, and I find men who are well on to seventy years of age capable of discerning signals at a distance of a mile and upwards.'

It is likewise reported that gunsmiths largely occupied in sighting guns get abnormal vision, and otherwise suffer by reason of strain upon the muscles of accommodation. This, probably, happens from the obliquity of direction entailed in performing the task.

The electric light is, by its intensity, known to damage the sight, inducing congestion of eye tissues, and, probably, internal irritation. This subject requires thorough investigation, now that electric lighting is extending so rapidly, and in all probability the case-books of eye hospitals can furnish data.

Among the misfortunes of their occupations, stone-dressers and masons, and iron-workers in forges and engine shops, get very frequently sharp particles of stone, or of iron, as the case may be, driven with force against the conjunctiva and cornea, frequently rendering the removal difficult; at times too, causing wounds, followed by opacities of the cornea, or even by ulterior injury to the interior of the eye, ending in blindness.

The sense of *hearing* undergoes injury from over-strain by excessive noise, as instanced in the case of boiler-makers and rivetters and of artillerymen. A hardness of hearing prevails also among the workmen in engineering shops; but

I have not noticed it in weaving-sheds, where the noise is even greater than in many fitting shops. And looking at facts, I would throw out the suggestion that sudden, interrupted, and strong vibrations, even when extended for brief periods only, are more hurtful to the ear than almost equally powerful ones in continuous action.

That the sense of *smell* may be weakened by occupation admits of many illustrations. Men working in the offensive trades carry on their labour with unconsciousness of its loathesomeness, unless some accidental cause modifies the stink in character or degree. The makers of snuff pursue their work in an atmosphere permeated by that article, which a non-habituated person cannot breathe for a minute without painful irritation of the mucous membrane of the eyes, nose, and mouth, ending in vascular injection and sneezing and mucous discharge.

Tea-tasters.—The sense of *taste* suffers after the same fashion as that of smell, but not so obviously, as a consequence of occupation. Tea-tasting lends itself as an example. When long-continued, the tasters lose the power of distinguishing the varying qualities of tea, and have to give up their business,—a surrender, however, perhaps more frequently enforced by the mischief of the occupation to the general nervous system.

The following account from the pen of Dr. Clapton, of St. Thomas's Hospital, of the disorders affecting tea-tasters, demands quotation, as the result of many original inquiries and of unusual opportunities for conducting them. The paper was read before the Hunterian Medical Society in 1873, and afterwards published in *Public Health.*

The symptoms bear a general resemblance in all cases. Dr. Clapton 'saw a few who had tasted for many years, and who yet enjoyed very good health, but many young men had been compelled to give up the practice on account of its prejudicial effects, and a large proportion of those who persevere suffer more or less from some of the following symptoms:—Depressing flatulence, especially before meals, often associated with a strong feeling of hunger, which, however, is soon satisfied; peculiar nervousness associated with

occasional faintness, and frequent disinclination to go to business; want of decision, and a strange sense of anxiety whilst at business, though the head is clear, and free from giddiness, and there is not the slightest tremor of the hands; inability to sleep well during the season—but they attribute this to extra work and harass in business; frequent diuresis; otherwise, as a rule, all the secretions are normal. Nausea and sickness are almost unknown amongst them. Many have red and congested throats, and red, cracked tongues, and not a few have slightly enlarged cervical glands. Irritation of the Schneiderian membrane, and ephemeral coryzas are common, but that is most likely from stirring and smelling the dry leaves. Appetite generally very good, though it soon passes away if the meals are not taken quite regularly.

'The majority of those who have tasted several years have noticeably small pupils; but, as a rule, very good sight. Notwithstanding that all that are out of health look pallid, and complain of general lassitude and weakness, yet they are very intolerant of tonics, whether bitter, vegetable, or ferruginous. As a rule, tea-tasters live very carefully and temperately; indeed, they are obliged to refrain from taking alcoholic stimulants in the slightest excess, otherwise their palate would be spoiled for tasting. Most of them smoke a little, both morning and evening; and they say that their particular taste is more discriminative than if they do not smoke at all. Green tea-tasting is apt to cause frequent attacks of biliousness. Assam tea is said to be more prejudicial, as being stronger, and having more of the volatile oil, which probably (and not the thein) is the chief cause of most of the above symptoms, on account of its volatility, for none of the infusion is actually swallowed in tasting. From thus observing the effect of tea upon tasters, I am convinced that, not only with them, but with all who partake largely of strong tea, it is not the thein which affects the cerebro-spinal nervous system, so much as the volatile oil. The latter possesses the odour and flavour of the tea in a high degree, whereas thein is almost odourless and tasteless. . . . It is doubtless to this volatile oil that the peculiar form of paralysis, almost like locomotor ataxy, is due, which the *packers* of tea are in course of time liable to' (p. 219).

The Skin.—The skin as a tactile organ and as a protective covering of the body, is liable to many changes due to the conditions of employment. As a tactile organ, it is adversely affected by all occupations which lead to its thickening, modify its density, or paralyse or benumb it. The commonest change it undergoes is a horny thickening which originates from handling more or less heavy and hard implements, or from the repeated action of strong heat, or from long-continued friction.

It likewise suffers with blisters raised by friction, chiefly seen among beginners at strong mechanical work. It becomes thickened and softened among laundresses, dyers, and bleachers; and in the soddened state is very subject to injury by laceration and puncture; and, in the case of the two latter trades, is open to additional injury by the presence of chemical substances.

Friction is the cause of the painful blisters on the skin from unaccustomed labour; and a good example of the consequence of prolonged pressure occurs in the enlarged bursa, known as 'housemaid's knees.' And similar formations are apt to arise on the hips and knees of miners from the same cause.

The business of straw-plaiting has its peculiar evils. Young girls learning the art get very sore fingers, difficult to heal from the friction of the straw, aggravated as it is by the previous bleaching of the material by sulphurous acid. And at all ages straw-plaiters suffer from sores on lips and tongue and lose their incisor teeth prematurely, owing to the custom of holding straws in the mouth whilst plaiting with the hands. Here we must suspect the sulphur acids still adherent to the material to be the provoking cause.

The skin, it is almost needless to say, is prone to injury in a number of trades where dry heat or scalding water is employed; and where oily materials are in pretty constant contact with it eruptive diseases are of frequent occurrence, as happens with petroleum and the oil used by woollen operatives.

The thickening of the integument is to be regarded as a protective arrangement, though one affected at the cost of

tactile sensibility. Local thickenings, often of large proportion, follow local pressure and rubbing, as seen in the shoulder-knots of porters, or in the hard swellings on the scalp of those who carry heavy weights on the head, as happens with potters' lads who so carry lumps of clay. Formerly the workers at handlooms developed similar thickenings, or bosses, over the ischial bones as a result of long sitting with more or less shuffling of the trunk upon their wooden stools.

The immense outgrowth of skin upon the ulnar edge of the left hand of calico and silk block-printers is another example of the condition under consideration; as is likewise the cushion-like production on the scalp at the vertex of the head in men or youths who push forward heavy weights by their heads, as is frequently done in coal mines; and, as French authors tell us, in stone quarries also, where small waggons have to be moved, and mechanical power is not at hand.

It would answer no useful end to quote all the employments in which pressure and friction develop hypertrophy of the cutaneous and subcutaneous tissues; for, as above intimated, we may look for it wherever those conditions are in operation locally.

In the case of colliers the frequency of scars upon their faces, hands, or other exposed parts of the body, of a deep blue or nearly blackish colour, is an identifying feature of their employment. These marks are due to wounds of the skin, into which the dust of coal has penetrated whilst still open. Their presence is explicable by what takes place in the well-known process of tattooing.

Of precisely similar origin are the black points met with on the left hand of masons using steel chisels in dressing stone. These marks are produced by detached particles of steel which penetrate the skin and remain in it, often for many months. The minute portions of the stone itself rarely penetrate, and so leave no marks.

Besides cutaneous thickenings or callosities of the hand from the use of tools, there occur at times structural changes of more import. The most serious lesion is that of contrac-

ture of the palmar fascia and fingers, a condition not very uncommon with carpenters and miners; caused in the former by the manner in which they hold and work chisels and some other tools, and in the latter, by the pressure and chafing of the end of the handle of the small and short 'picks' used in dislodging coal. Some writers have represented this disabling deformity as common among colliers; but my inquiries do not support this opinion.

I have no knowledge of the fact among English silk operatives,—it may be, because the particular occupation is little followed; but Dr. Givre states that the development of whitlows on the fingers is a trade peculiarity with those engaged in unwinding silk cocoons. This fact he accounts for by the constant immersion of the fingers in hot water, and their contact with the gummy matter of the silk, to which he assigns noxious qualities. It appears to be an incident observed by several physicians practising in silk-making towns on the Continent.

Other disasters mentioned by him as happening to these operatives are, lateral curvature of the spine, due to the oblique position in which they sit when at work, and hypertrophy of the right arm and shoulder consequent on almost all the work falling to that extremity.

The Muscular System is considerably affected by over-use and strain. It is a commonplace in physiology that the active use of muscles leads to increased growth or hypertrophy, and the development seen in a smith's arm is the usual illustration given. But there is such a thing as over-use, which, instead of adding to and strengthening muscular tissue, does the reverse, and, besides, sets up in its fibres irregular contractions or spasms, with pain and cramp, and, at times, paralysis. The default, indeed, is not wholly muscular, but, in a considerable measure, nervous. There is undue wear and tear of muscular tissue, and this cannot be prolonged without involving the nerve-supply of the part over-used. A man may lose power over his lower extremities by excessive walking, but the effects of the overstrain do not exhaust themselves in the muscles, but make themselves apparent

in disturbed function of the spinal cord, which may proceed so far as to develop organic changes with permanent detriment to muscular and nervous energy.

Again, in muscles insufficiently used, or practically disused, there are attendant loss of power and wasting; as exemplified by the usually meagre development of muscles in persons following sedentary occupations; and, in a more pronounced form, where movement has been arrested by paralysis or joint disease.

The most interesting examples of defaulting muscular power from excessive use, are seen in those local pareses represented by scriveners' paralysis, hammermen's palsy, and many other analogous disorders met with in sundry occupations where some portions of the body, usually the hands and fingers, are over-exercised. Illustrations are furnished by the occasional paralysis of the fingers among pianists and violinists, among harpists and scriveners. At times, cramp rather than actual loss of power is the more observable, and follows upon too long fixity of activity and position in the affected segment of the body. Thus we read of tailors' and embroiderers' and of writers' and dancers' cramp.

Whatever be the long practised movements, the onset of the paretic condition arrests their execution, and the loss of power is commonly accompanied by pain. When cramp is the leading feature, hyperæsthesis often goes with it, and this perverted nervous state will, at times, radiate widely from the affected part, even so far as to involve the whole body. An illustrative case is recorded in the remarks on carpenters, borrowed from Sir Peter Eade. Dr. W. Frank Smith, of Sheffield, gives other examples, described under the high-sounding name of 'Hephæstic hemiplegia,' or hammer palsy, (*Lancet* 1869, p. 427), which should be read in detail. In one of them there was no spasm, but a spreading paralysis. The cause was prolonged working with a heavy (seven pound) hammer, and continuing to work after fatigue was experienced. The form of paresis was right hemiplegic, with vertigo, ptosis of right eye, and mouth drawn to left side. The first symptom was convulsion of the right arm; the man felt insensibility and inability to speak, though he understood what was said. Touch was unimpaired; the hearing of right ear defective, and

micturition rather difficult. In a less severe case, there were only coldness, numbness, and weakness of the arm, and dragging of leg of same side, indistinct speech, and vertigo. A third case was similar to the last, with loss of power to grasp, and twitchings of muscles. A fourth was hemiplegic, but free from aphasia.

Absolute rest, phosphorus, strychnia, and cod-liver oil effected a speedy cure.

Miners' nystagmus is another example of paresis and spasm from overstrain of some of the ocular muscles (see p. 274). This spasmodic and somewhat paretic disorder is, however, not restricted to miners; for Mr. Snell, who has made the condition a special study, narrated a case before the Ophthalmological Society in July 1891, that happened in a young compositor, who was in the habit, when looking at his 'copy,' of raising his eyes only, without at the same time elevating his head. His recovery followed on giving up this practice, which, without doubt, involved extra strain upon the orbital muscles.

Duchenne of Boulogne supplies a further illustration in the case of a gentleman devoted to deciphering manuscript, and whose sight was very good. After some years of this fatiguing labour, he experienced double vision whenever he fixed his eyes on any object; a circumstance M. Duchenne found to be owing to spasmodic contraction of the right rectus muscle of his left eye, and that the exercise of vision in any other direction was unattended by any divergence.

With respect to coal-miners, I entertain the notion, from my own observation, that a prominence of the eyes is common, and that it is due to a relaxed state of the ocular muscles.

Sir Crichton Browne (*Book of Health*), describes choreitic movements of the hands and fingers amongst girls in the button-making trade, due to erethism of the nerve centres of the brain from perpetually dealing with minute objects in a monotonous fashion.

To the same list of industrial ailments is to be assigned the morbid condition called 'dentists' leg,' due to overstrain and fatigue from prolonged muscular contraction in a fixed position, entailing also impeded circulation in the limb from pressure upon both arteries and veins, particularly the latter.

The defective circulation manifests itself in the nerves by the production of various perverted sensations, such as scalding, numbness, and prickling. On this subject, the able paper by Mr. Oakley Coles, published in the *Transactions of the Odontological Society*, vol. xvi., may be consulted with advantage.

The conformation of the hand is, to a considerable degree, a trade mark, and has been discussed by Vernois in a special treatise. His refinements in description we cannot follow. Sir Peter Eade, of Norwich, has also given attention to this same subject; and, in preceding descriptions of trades, various facts relating to it have been detailed.

The history of file-cutters shows that from over-use of the right hand in working their hammers—weighing from seven and a half pounds to three pounds—the hand and wrist become weak and wasted; while from the pressure of the chisel, the left thumb gets stunted in its growth, and generally bent backward. At the same time, friction produces warty growths on the skin, and knotty swelling upon the tendons of the wrists. Moreover, the sitting astride their working seat gives rise to bow legs, and their inclined position at work produces round shoulders and narrowed chests.

Dr. Allbutt gives credit to it as a fact that the constant use of the hammer by file-cutters, after primarily producing hypertrophy of the biceps—according to the general physiological law—ends, after the work has been long carried on, in wasting of that muscle. In discussing this phenomenon, it is necessary to remember the almost constant occurrence of plumbism among these artisans, and that it is possible that the atrophy may partially at least be due to the lead. And probably this same factor is answerable for the wasting of the hand and wrist of the right limb.

The general framework of the body bears witness to the effects of unequal use and pressure of its several members, by the production of deformities.

Round shoulders or spinal curvature forward, and more or less lateral curvature, are among the commonest consequences of employment. The elevation of the left shoulder above the right, with compression of the same side of the chest, is an abnormality of potters' throwers, brought about,

by their manner of working, viz., with the left elbow and arm fixed and pressed against the ribs, whilst the other arm is freely moved.

The one-sidedness of nailmakers and lockmakers is very pronounced, amounting in some old hands to great deformity. And the frequently mis-shapen limbs and bent bodies of tailors, shoemakers and miners furnish examples of what constrained attitudes will bring about.

Shoemakers working with the 'last' pressing against the chest, acquired as a trade mark a remarkable spoonlike concavity of the breast bone.

Nurse girls, from carrying children on one arm, get lateral curvature of the spine and general one-sidedness. This occurrence is becoming less common than formerly, owing to the almost universal adoption of perambulators.

'Silk-twisting' by hand is still carried on in Leek, for making the best and strongest twists for tailors' use. It is a cause of bodily deformity, though to a greatly less extent than formerly, when quite young children were employed. To perform it, several silk fibres are connected with a wheel, resembling in general details the old rope-spinning wheels, turned by a man. The fibres are at the same time disposed on a wooden frame held by the assistant lad, who runs rapidly to and fro in the long shop, bearing this somewhat heavy implement in one hand held out from the body at nearly a right-angle. The consequence is, a twisting of the trunk to that side, producing lateral spinal curvature, and also knee-deformity, from the inequality of weight on the two legs. The work is usually done on bare feet, and it is estimated that a lad will run from ten to twelve miles in the course of the day. Another result, when this labour is commenced too early, is the production of flat feet.

Turning attention to the lower extremities, examples of changes in conformation due to occupation do not fail us. Jockeys and others engaged much in riding frequently present bow-legs. Ballet-dancers suffer subluxation with increased growth of the great toe, accompanied often by inflammatory attacks and great pain. At the same time they possess ample development of the calves of the legs, and, indeed, of the legs at large, as physiological teaching would lead us to expect.

Work-people obliged to stand long, and especially when this happens in early youth, lose the arch of the foot and become flat-footed, with deformed ankles and often 'knock-knees.' These deformities are described as frequent among children and young persons before the Factory Act limited the hours of labour and premature employment.

The following are put forward by Mr. Arbuthnot Lane (*Lancet*, August 9th, 1890), as fundamental laws presiding over the production of deformities, especially in young life:—'(1) Not only do the forms of the bones of the human adult skeleton vary with such movements as are performed habitually, or with such routine attitudes as are assumed by the vigorous individual, but also do the details of the structure and the functions of the several joints. (2) If an individual is habitually engaged in performing a certain movement or sequence of movements of activity, the form of the skeleton varies from the normal in a degree which is proportionate to the length of the period during which the movement has been performed, and to the amount of energy expended in the act. During a single performance of the attitude of activity there are present numerous tendencies for the bones and joints to undergo changes in form. The constant repetition enables the tendencies to become actualities. The earliest variation from the normal consists in the fixation of the physiological attitude, which is normally pursued during the performance of such a movement of activity, while the later changes are exaggerations of the same attitude due to changes in the bones and in the intervening soft structures. In other words, the peculiar character of the anatomy of the labourer is, first the fixation, and subsequently the exaggeration of a normal physiological attitude of activity. (3) For the so-called normal condition of the skeleton, it is necessary that during growing life the individual shall combine attitudes of activity with attitudes of rest, and that the attitudes of activity as well as those of rest be varied in character. (4) During the period of a single assumption of an attitude of rest there exist tendencies to change, both in the form of the bones and of the joints.'

I will not further quote Mr. Lane's exposition of the remaining laws regulating the play of forces upon the skeleton,

as they apply particularly to the phenomena of child growth; but recommend every one desirous of a philosophical insight concerning deformities, to study the essay quoted, and to read, in connection with it, the other contributions made by this distinguished surgeon.

Besides injuries to the skin, the muscles and the locomotor appendages, there occur others, often of serious character to internal viscera, assignable to strain and over exercise. With respect to the thoracic viscera we encounter emphysema, heart disease, and aneurism. Mechanical emphysema is not a frequent phenomenon, but heart strain is so. Both may arise from violent athletic exercise; and in the case of heart strain one of the most notable causes is rowing. Running contributes to the same result, and I think that it will be well to take note of the physical condition of cyclists, who from rivalry undertake feats of strength and endurance that cannot fail, sooner or later, to leave their marks upon the respiratory and circulatory systems. Fast riding of a bicycle entails great and continuous strain upon the lungs and compression of the chest; and the physiognomy of the riders is that of men not enjoying their exercise, but suffering from it, and oppressed with anxiety and impeded respiration. Another drawback to the exercise is the very stooping position usually assumed. Aneurism is an accident that will happen in laborious occupations requiring sudden exertion. Hence smiths, anchor-makers, strikers, porters, and dock loaders furnish a larger proportion of aneurism than other trades; and where this lesion does not happen, we may look for cardiac mischief, in the shape of damage to the aortic valves, chronic inflammatory change, atheroma and incompetence. In olden time, when 'post-boys' were greatly in request, we read of popliteal aneurism as of common occurrence with them.

Strain, lastly, is the cause of lesion in the abdominal cavity, almost always in the form of outward hernia, although internal displacement and strangulation are not unknown. As force is the active agent in its development, hernia, like aneurism, is met with chiefly in occupations requiring strong, and especially sudden effort—as in the case of the employments just now enumerated, and not a few others, such as

millers, carpenters, and quarrymen. Likewise seamen on board sailing ships often get hernia from pressure on the belly against the yards when they have to take in, or shorten sail, whilst at the same time strongly exerting themselves by the hands. In the case of athletes, muscular strain falls on various parts of the body, according to the exploits they exhibit; and it may be said of these specimens of muscular power that they are short-lived—a circumstance for the most part arising from heart strain. On the whole subject of strain in its connection with the presence of heart disease, an admirable essay was written by Dr. Clifford Allbutt in the *St. George's Hospital Reports* of 1871. To him the greatest credit is due for so clearly demonstrating the operation of over-work and over-strain in the production of. cardiac disease, factors that had previously been overlooked or neglected by pathologists. It is enough to call the reader's attention to this article; for to embark upon the description of the consequences of heart strain would call for a pathological dissertation out of place in this book. Dr. Allbutt cites cases of the accident in soldiers, forgemen, colliers, wharfingers, rivetters, athletes, runners, heavy-porters, stonemasons, and others using strong exertions or subjected to sudden and violent efforts.

GROUP VIII.

EXPOSURE TO INFECTION AND CONTAGION.

Infection and Contagion as causes of sickness in several occupations have received attention in preceding chapters, in connection with materials charged therewith. Examples of exposure to contagious disease are found among dairymen, cattle-dealers, slaughterers and skin-dressers, grooms and veterinary surgeons. This subject has been treated of also in the account of wool, hair, and rag-sorting. So, again, it has been shown that rag-sorting is now and then chargeable with the spread of zymotic diseases; that these same maladies are suspected occasionally to seize upon those who feed and milk cattle by the medium of contagion derived from the cattle; that skin diseases are transferable from the latter to man;

besides the far more serious maladies of farcy and glanders from the horse. The inoculation of dairymen by cowpox needs only to be mentioned. The propagation of zymotic disease by the domestic cat has of late been insisted upon as a fact, and we are unhappily too familiar with the origin of rabies from the dog. However, these last-named contagia have no necessary connection with any particular occupation, excepting that of veterinary surgeons, who run the most risk from them in following their profession, inasmuch as they are expected by the public to take in hand the treatment of all the larger specimens of the animal world when sick and afflicted.

Further elaboration of these topics seems uncalled for.

CONCLUDING CHAPTER

HYGIENIC PROVISIONS AGAINST DISEASES OF OCCUPATION

A FEW general remarks on preventive measures against the incidence of diseases of occupation appear to me not out of place in a concluding chapter to the present work. Many measures of this class have been already pointed out in the description of the several forms of employment. A complete account of such, and of their adaptation to each particular description of labour, would call for a special treatise. But the perusal of the foregoing chapters will suffice to show that the principal causes of ill-health following upon occupation are reducible to a small number; but these of wide range. Their fewness equally makes it possible to indicate in outline the methods available to limit the degree and extent of their action within a brief compass.

Of the insanitary causes spoken of I would make four groups, as follow, viz.:—1. Want of outdoor bodily exercise, often associated with constrained positions of the body; 2. abuse of food and drink; 3. needless exposure to the causes

of ill-health found in places of work; and 4. deficient ventilation and working space.

A. The *first*-named group exists especially in the large class of sedentary occupations, but more, or fewer, of the remaining groups may co-operate with it as disease-producing factors. At the same time, the unhealthy conditions included in it are, speaking generally, preventible or, at least, remediable to a considerable extent. Much work must be done within doors, and many hours a day be devoted to it; still, it is quite possible to limit the duration of labour, to lessen the evils of confinement by judicious ventilation, and to set apart more or fewer hours for outdoor exercise and diversion. It is equally practicable, in many instances, if not to set aside altogether, at least to reduce in degree the constrained posture assumed at work. This end has been attained pretty fully in the trade of shoe-making, and to a minor extent in the occupation of clerks, in which high desks and the standing posture are now resorted to in place of perpetual sitting, as of old, in a bent position at their work. And it is quite conceivable that an alteration in the same direction might be made in a large proportion of sedentary trades, where custom dictates sitting at low working benches with greater or less inclination forward of the head and chest. For it is certain, that it is nothing but custom that dictates in most instances the unhealthy postures of many artisans. The reverse state of things, that of excessive standing, is an equally pernicious custom, and, to a great extent, avoidable. The tyranny of trade usage enforces it, particularly in the case of shopmen and shopwomen engaged in the sale of textile goods, to whom it is unlawful to sit even when there is opportunity; and nothing short of a general revolt against the practice seems likely to put a stop to it.

With reference to the curtailment of working hours and the securing of a portion of time for outdoor air and exercise, much is practicable by the combined, harmonious action of employers and employed. The Factory Act has done much in this direction by limiting the hours of labour for all females and children, and by prescribing a fixed period for meals. The latter provision might well bear extension,

especially where workmen have to travel a distance to and from home within the allotted dinner hour. One way of meeting the difficulty is by providing in factories a room for taking meals, and furnished with means for cooking or warming food. This expedient has of late years been increasingly adopted in large establishments.

But, again, in numerous employments, and in retail trades generally, the employed possess sufficient control over the disposal of their time, to enable them to set apart some portion of it for the purposes of outdoor exercise and diversion. That employed people do not more fully avail themselves of their opportunities is owing to their want of the knowledge of the laws of health, to avarice, and to the rivalry of neighbouring tradesmen. Acts of Parliament are invoked to enforce limits to the duration of labour in the case of shopkeepers; but these, if obtained, would be failures, a cause of perpetual annoyance, and obstacles to freedom of action to be ignored or evaded, besides involving a meddlesome amount of inspection. The object aimed at, so far as attainable, must be accomplished by those themselves concerned, when sufficient sanitary enlightenment reaches them.

Those who desire to emancipate themselves from the toils of pernicious trade customs should find encouragement in the rapid advance of sanitary science, and in the philanthropic activity of the present era. These are the auxiliaries to be invoked.

B. The *second* group of causes of diseases among the employed belongs to the category of preventible conditions, and is, besides, no speciality of people engaged in labour. Nevertheless, it is one that is answerable for a vast amount of sickness and sadness among the working classes.

Intemperance in alcoholic beverages is a pervading sin of British workmen, and a potent factor in developing disease among them and in shortening their days. It here calls for no examination; but abuse of food has not arrested the attention it deserves, because its results are not at once and very obviously perceptible, as are those of 'drink'; yet I am persuaded that much harm follows upon the prevailing ignorance and disregard of the subject. Workmen grievously

err in the selection, preparation, and cooking of food. The popular notion is that health and strength are to be found in direct proportion to the quantity of solid food put into the stomach, especially so if that food be butchers' meat, and can, in addition, be washed down advantageously with copious draughts of beer. This addiction to solid, and particularly animal, food is witnessed alike, whether the work carried on be active and outdoor, or indoor and sedentary. In consequence, though chiefly in the less active employments, a condition of plethora is induced, and sooner or later disease, mostly in a chronic form, ensues.

The enormous increase in the consumption of animal food in England is a phenomenon of the present generation; but the profit gained thereby in the working capacity of the population is problematical. Our labouring forefathers performed equally hard tasks, and almost invariably for longer periods than at the present day, upon a dietary in which meat was almost a stranger, except, perhaps, on one or two days in the week; and there is no conclusive proof that they were any the worse for the regimen. The same holds true with regard to the workmen of France and Germany, who, by surpassing those of our own country in patient industry, have become serious rivals in the arts and manufactures.

These remarks on over-feeding apply more widely to men; for in the instance of the majority of women engaged in manufactures, an opposite condition prevails, viz., imperfect nutrition from the abuse of tea.

C. *Unnecessary Exposure to Circumstances of Employment* is fertile in the production of disease among workmen, particularly in the larger kinds of manufacture and in mining.

Familiarity with machinery, with dangerous and dusty processes, and with exposure to heat, steam effluvia, and poisonous emanations, leads far too frequently to recklessness. This last is a circumstance that besets, apparently in a higher degree, men employed in the rougher kinds of labour, and in those forms where the task is charged with unusual disagreeables and perils. Those engaged with machinery frequently seem, by familiarity, oblivious of its dangers. The

workers with poisonous materials like lead, deal often with them as if harmless, with consequent sacrifice of health.

When human ingenuity and skill have done all that is possible to remove causes of illness present in machinery, in materials employed and in the methods of work, the consequences of exposure and carelessness consciously remain within the control of the employed.

It has been pointed out that the frequent connection of recklessness and dangerous occupations, is largely owing to the inferior grade of society from which such occupations draw their recruits. Here amendment can only be looked for in the advance of civilisation, in improved moral tone, and in the spread of education and intelligence, and of orderly and temperate habits.

Another widely spread description of exposure is that to heat and cold in states of the body that render it unusually susceptible to their influence. This is exemplified largely in the case of mill hands, who make the transit from the heated work-rooms into the external air, regardless of the difference of temperature, and of fitting clothing. The same thing is met with among men working in forges, in mines, and among machinery where strong currents of cold air prevail.

Means to obviate all such and a multitude of like morbid factors, are to be found in the exercise of more prudence on the part of the workers, in the observance of great cleanliness, in sensible clothing, and in arrangements for preventing overheating and the prevalence of draughts.

D. *Defects in Ventilation and in Working Space.*—These surpass in their disastrous effects on the health of the employed, all other injurious conditions taken together. Scarcely any places of occupation are devoid of them; though they abound more in the workshops of mechanical trades, and in manufactories. In not a few instances defective ventilation and working space represent almost the whole of the conditions recognisable as prejudicial to health; especially is this the case in many simple handicrafts and in purely sedentary employments. In spacious and well ventilated work-rooms the ill consequences of all industrial pursuits are

reduced to the minimum; whether the disease-producing agent be dust, or noxious vapours, or gases, or heat, or a distinctly poisonous material. As a matter of course the amount of, and the details for, efficient ventilation will have to be varied according to the peculiarities of the business carried on and the construction of the factory. In the past no subject has been more misunderstood than ventilation proper. Currents of air and injurious draughts have been the only product of many plans employed, and in consequence a wide-spread prejudice against schemes of ventilation has prevailed among operatives. Of late years, happily, the skill of engineers has successfully developed efficient modes of ventilation without draughts or annoyance to the people working in shops; chiefly by the introduction of fans driven by steam power. By their action fresh air is introduced and polluted, overheated and dusty air is withdrawn; and it frequently also is supplemented and strengthened by auxiliary arrangements. Various forms of fans have been devised and patented, and bear the names commonly of their inventors, who do not fail to advertise their excellencies, and thereby render description here quite unnecessary.

The very numerous businesses, chemical and others, productive of noisome and sometimes actively poisonous effluvia, call for special structural arrangements to protect their own workers, and still more the surrounding population, from the consequences of their escape. What has been done, and what should be done in the case of such factories, is admirably and fully described in Dr. Edward Ballard's exhaustive reports on effluvia nuisances, so largely referred to in the foregoing pages.

For withdrawing dust nothing appears more efficient than the 'exhaust' fans which are fast coming into use in all factories of any magnitude where steam-power is available. Unfortunately, there are numerous small factories and workshops greatly needing their application, but where steam-power is absent, and fans consequently not practicable. However, in most such places gas engines might be introduced; and it is to be hoped that the increased powers lodged in the hands of factory inspectors, by the sanitary clauses of the amended act of last year, may suffice ere long to secure

the use of fans in all workshops where offensive and dusty operations are carried on. Indeed, it will not be long before electricity will be available as the motor force in driving ventilating and other machines requisite for manufacturing purposes. In the case of lead, chemical, and alkali works, it is only in certain parts that there is a want of fresh air; but the workplaces found in them are usually rough and ill-kept, where, too, noxious dusts, or gases, or vapours accumulate, ready for dispersion, and where unprotected sources of danger exist in and about furnaces and conduits for caustic fluids; together with narrow gangways, and shaky ladders and platforms. In such establishments, notwithstanding the usual free access of air obtained by rough shed-like structures, there is still often need for ventilation in the strict sense of the word, to dissipate the vapours and effluvia poured forth, or the dust set free.

In factories of the same sort 'fencing' is largely called for, a requirement that falls to the duty of the factory inspectors to see met.

A very common cause of depraved health in factories of all sorts is the large and too often wasteful consumption of coal gas; chargeable with the production of needless heat and of the vitiation of the air by the gaseous products of combustion. Now where, as in many factories, long rows of gas jets are in use, special arrangements to collect and carry off the burnt gas should be made. The wasteful use is remediable only by the exercise of common sense and prudence. The extinction of this form of sanitary evil will follow when the electric light becomes the general illuminating medium.

I have remarked on the peculiar sensitiveness of indoor workers, whose occupation is sedentary, to the feeling of cold. It grows with them to a morbid dread; and it is made worse by limited space and defective ventilation. Moreover, my belief is that the plan of warming workshops by heated pipes provokes this sensitiveness, renders the shops unwholesome, and gives rise to a stuffy, disagreeable atmosphere for breathing. It were better, I doubt not, that the artisans in a shop should suffer from a chilly atmosphere than exist in one well warmed by hot air, steam, or hot-water pipes. The remedy

for these evils is a sufficiently frequent and full interchange of air in the shops by mechanical ventilating apparatus.

Ventilation and working space are contributory to cleanliness in labour, a condition too frequently lost sight of. Attention to cleanliness makes nearly all the difference,—sanitary arrangements being the same,—as to whether an occupation is pursued with or without detriment to health. A concurrent requisite is carefulness and neatness in work. There must be cleanliness of person, of the working place, and of the clothes. Proper regard had to this particular explains, to a great extent, the escape of one workman from the ills that waylay another engaged in the same trade; and often dispenses with the facile hypothesis of idiosyncracy to afford an interpretation.

Examples of the fact are common among workers handling poisonous material; and even where dust is the sole cause of illness the cleanly careful operative escapes, whilst his negligent neighbour succumbs to it.

To further particularise methods for obviating trade diseases is beyond my present purpose. The general notice of such now given must suffice. The axiom that prevention is better than cure need be brought home to the mind of our operatives, who far too often ignore and neglect preventive measures, and, in consequence, do not awake to the ills of their calling until these have advanced beyond remedy.